International Workshop
"Digital Innovation in Finance"

⟨ Special Invited Speaker ⟩

Stanley R. Pliska	Univerisity of Illinois at Chicago, USA

⟨ Plenary Speakers ⟩

Ning Cai	Hong Kong University of Science and Technology, Hong Kong
Wolfgang Härdle	Humboldt-Universität zu Berlin, Germany
Masayuki Kazato	Bank of Japan, Japan
Tim Loughran	University of Notre Dame, USA

⟨ Tutorial Speaker ⟩

Rostislav Berezovskiy	FinForge cryptolab, Russia
(Chair) Yuri Kabanov	University of Franche-Comté, France

December 10, 2018 (Mon) 13:00 - 17:15
December 11, 2018 (Tue) 10:00 - 16:55

North Building Hall, Mita Campus, Keio University

慶応大学
Centre for Finance, Technology and Economics, Keio University

広島大学　情報科学部
School of Informatics and Data Science, Hiroshima University

首都大学東京　金融工学研究センター
Research Center for Quatitative Finance, Tokyo Metropolitan University

Organizing Committee

Masaaki Kijima	Hiroshima University, Japan
Steven Kou	Boston University, USA
Yukio Muromachi	Tokyo Metropolitan University, Japan
Teruo Nakatsuma	Keio University, Japan
Hiroshi Takahashi	Keio University, Japan
Tomonori Uchiyama	Tokyo Metropolitan University, Japan

Organized by Centre for Finance, Technology and Economics, Keio University
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Research Center for Quatitative Finance, Tokyo Metropolitan University

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Program

December 10, 2018 (Mon) North Building Hall, Mita Campus, Keio University
Registration starts at 12:30

Opening address

13:00-13:10 **Yukihiro Ikeda** Keio University

Plenary speech

13:10-13:55 **Tim Loughran** University of Notre Dame
"Readability: What We Cannot Measure in Business Disclosures"

Contributed Talk

13:55-14:20 **Hironori Nishiie** Credit Pricing Corporation
"Analysis of the Relationship between Corporate Organizational Culture and Financial Performance Using Company Employee Reviews"
(with Hiroshi Tsuda)

14:20-14:45 **Xueyin Qu** Keio University, Japan
"Building a Financial Polarity Dictionary Using Stock Price Information: Analysis and Verification in Chinese Stock Markets"
(with Aiko Suge and Hiroshi Takahashi)

Plenary speech

15:10-15:55 **Masayuki Kazato** Bank of Japan
"Tone Analysis on Monetary Policy: Interaction between Bank of Japan's Policy Explanations and Newspaper Reports"
(with Tetsuo Kurosaki and Keiichi Goshima)

Contributed Talk

15:55-16:20 **Tomonori Uchiyama** Tokyo Metropolitan University
"Return Predictability and Machine Learning: Dangers of Data-Mining"
(with Hideaki Takizawa and Tadashi Kikugawa)

16:20-16:45 **Masaki Nakabayashi** Mizuho Securities Co., Ltd.
"A Chaos Expansion Approach for the Non-Linear Fractional Filtering Problems"
(with Hideharu Funahashi)

Special invited talk

17:05-17:50 **Stanley R. Pliska** University of Illinois at Chicago
"Electric Market Making: Potential Profits and Research Opportunities"

December 11, 2018 (Tue) North Building Hall, Mita Campus, Keio University
Registration starts at 09:30

Plenary speech

10:00-10:45 **Ning Cai** Hong Kong University of Science and Technology
"Econometrics with Privacy Preservation"
(with Steven Kou)

10:45-11:30 **Wolfgang Karl Härdle** Humboldt-Universität zu Berlin
"Understanding Crypto Currencies"

Tutorial talk chair: Yuri Kabanov

13:00-14:30 **Rostislav Berezovskiy** FinForge cryptolab
"Blocks, Transactions and Prices"

Contributed talk (Japanese language session)

14:50-15:15 **菊地剛正** 慶應義塾大学
"金融ネットワークモデルをベースとしたビジネスゲームと
ファシリテーション支援枠組みの提案"
(田中祐史，國上真章，山田隆志，高橋大志，寺野隆雄との共同研究)

15:15-15:40 **小室幸人** 東京工業大学
"企業間の類似性と M&A: テキスト分析アプローチ"
(池田直史，井上光太郎との共同研究)

15:40-16:05 **松本裕介** 慶應義塾大学
"Analysing the Relationship between the Synergy Effect and Divestment
in M&A through the Mixture Model"
(菅愛子，高橋大志との共同研究)

Contributed talk

16:25-16:50 **佐藤隆清** 東京工業大学
"有価証券報告書のテキストマイニングによる株式のリスクファクター分析"
(池田直史，井上光太郎との共同研究)

16:50-17:15 **伊藤彰朗** 野村アセットマネジメント
"マルチアセット市場におけるスペシフィック・リターンに着目した投資戦略"
(中川慧との共同研究)

December 10, 13:10-13:55 Plenary speech

Readability: What We Cannot Measure in Business Disclosures

Tim Loughran

University of Notre Dame

The central issue in readability is considering what is meant by the concept within the framework of business writing. The strongest argument against the use of traditional readability measures, like the Fog Index, in business disclosures is the observation that the vast majority of these documents are not distinguished by their writing style. If the intention is to measure document readability, then researchers face the problem of separating the business and the disclosure document. These issues are intertwined because the firm's disclosure document attempts to describe the economic reality of their business. Researchers might be better off focusing on the broader topic of information complexity and avoiding the term readability.

Contributed talk December 10, 13:55-14:20

Analysis of the Relationship between Corporate Organizational Culture and Financial Performance using Company Employee Reviews

Hironori Nishiie

Credit Pricing Corporation

We analyze the relationship between “Corporate Organizational Culture Score”, which is quantified by text mining and machine learning for online employee reviews on Japanese listed companies, and their financial or equity performance. We find (1) sales decrease along with the low score, (2) debt ratio increases along with the score worsening, (3) the long-short portfolio, constructed by improvement group and aggravation group defined by the score change, has statistically significant positive alpha (α) measured by Fama-French three or five Factor Model. Our research suggests that online company reviews contain useful information for the practice of corporate valuation.

Joint work with Hiroshi Tsuda (Doshisha University).

December 10, 14:20-14:45 Contributed talk

Building a Financial Polarity Dictionary Using Stock Price Information: Analysis and Verification in Chinese Stock Markets

Xueyin Qu

Keio University

In recent years, a lot of news articles related to stocks are posted on the Internet, and many empirical studies explaining the relationship between financial market fluctuations and news articles through text mining have been done. However, there is only a few direct research papers related to word polarity between news articles and the stock price information in the Chinese market. Therefore such research needs to be conducted.This paper proposes a method of building a sentiment dictionary using news articles as well as stock prices in the Chinese market through textual analysis in finance. We analyzed 19,535 news articles provided by Hexun Site in 2014. And the stock prices were provided by Tonghuashun financial data online service system.In order to obtain the amount of word polarity, we associated the news articles' one-hot wordlist with a score.The score is calculated by the method of event study with the abnormal change rate of stock prices on the publishing date. Through several attempts, we set the estimation window to start from 140 days before the publishing date and to end 21 days before the publishing date, which lasts for 120 days. And the event window starts from one day before the publishing date and ends the day after the publishing date, which lasts for 3 days. In the estimation window, we presume the risk parameters of the Fama-French 3-factor model of every stock which is mentioned in the articles. In this study, the standardized cumulative abnormal return (SCAR) was used as the score of the news articles.The wordlist was refined with deletion of stop words and each word's TF-IDF values were calculated for evaluating the importance. Through several attempts, top 10,000 words are placed in the keyword list.Then, we associated the one-hot list of news articles with the score into the training data set. Support vector regression (SVR) was conducted to build a sentiment dictionary with polarity data from the normal vector. Furthermore, we made a prediction for news articles' score. In this analysis, the in-sample verification's classification accuracy was about 60%. In addition, a comparison to renowned sentiment dictionary was made. According to the sentiment dictionary we made, adjectives that express feelings and psychological states with polarities are quite reasonable, but it is necessary to improve the polarities of nouns and verbs. A large number of data samples might improve the accuracy.

Joint work with Aiko Suge (Keio University) and Hiroshi Takahashi (Keio University).

Plenary speech December 10, 15:10-15:55

Tone Analysis on Monetary Policy: Interaction between Bank of Japan's Policy Explanations and Newspaper Reports

Masayuki Kazato

Bank of Japan

The central bank communications plays a very important role in conducting monetary policy in advanced economies. Central banks are expected to carry out their policy by providing relevant information about their policy decisions and intentions as well as monitoring how disclosed information is disseminated to the general public through media reports. Given these observations, we carry out the tone analysis on Bank of Japan's monetary policy by quantifying tones of both Bank of Japan's policy explanations and their newspaper reports. We estimate such tones by employing a state-of-the-art methodology of deep learning technique. We also extract tone shocks from estimated tones conveyed by the Bank of Japan in a more precise manner by employing a large number of economic and financial variables to control readily available components in the estimated tones. We then show that tones of newspaper reports are significantly influenced by the tone shocks of policy explanations under Governor Kuroda's regime since 2013. We also find that the positive tone shocks lower volatility in the overnight index swap market and such effects become larger under Governor Kuroda's regime.

Joint work with Tetsuo Kurosaki (Bank of Japan) and Keiichi Goshima (Bank of Japan).

December 10, 15:55-16:20 Contributed talk

Return Predictability and Machine Learning: Dangers of Data-Mining

Tomonori Uchiyama

Tokyo Metropolitan University

Standard finance theory states that returns on assets are predictable. However finding empirical evidence of predictability is statistically difficult. Data-mining for detecting more significant evidence leads to overfitting, by which it looks like significant in appearance but is senseless in fact. Particularly in recent years, an enormous amount of information or big data becomes available at low cost, and machine learning attracts an increasing interest in engineering aspects. Big data and machine learning can contribute to improvement in prediction accuracy, while they increase possibility of overfitting. This study considers data-mining with both variable selection and model selection for return predictability in the time-series. Our results demonstrate that overfitting makes large degree of influence on backtests, giving rise to specious identifications.

Joint work with Hideaki Takizawa (Nomura Securities Co., Ltd.) and Tadashi Kikugawa (Nomura Securities Co., Ltd.).

Contributed talk December 10, 16:20-16:45

A Chaos Expansion Approach for the Non-Linear Fractional Filtering Problems

Masaki Nakabayashi

Mizuho Securities Co., Ltd.

This paper investigates the optimal Kalman-Bucy filtering problems in the non-linear system driven by fractional Brownian motions. The Kalman-Bucy filter is a continuous counterpart of the Kalman filter which has numerous applications in technology traditionally in control theory and recently in the field of AI. The Kalman filters are based on linear dynamical systems discretized in the time domain with Gaussian noise. However in practice, the assumption of linearity and Gaussianity may not be applicable. For this reason, the Kalman filters have been extended in various ways such as extended Kalman filter and unscented Kalman filter. Another approach proposed in literature is to solve the problem in numerical way using particle filters based on Monte Carlo algorithm. In our research, we have approached this problem in different way. We first regard the Kalman filtering problem as a discretized version of the Kalman-Bucy filtering problem for the sake of analytical tractability. We then develop an approximated formula for the Kalman-Bucy filtering problem using the Chaos expansion technique proposed by Funahashi and Kijima (2015). Specifically, we use the technique to approximate the conditional probability density function of optimal filter which is a key of this problem. Based on this idea, we show that the conditional probability function can be approximated using multivariate Hermite polynomials, and that the calculation of them can be performed efficiently using algorithms proposed by Chacon and Duong (2015). One of the key feature in our algorithm is that it allows wide range of volatility model and further allows a fractional Brownian motions as a noise. This relaxes assumptions typically imposed in the Kalman-Bucy filter. Through ample numerical examples, we show that the accuracy of our approximations is high under various diffusion models.

Reference

1. Funahashi, H. and M. Kijima (2015), "A chaos expansion approach for the pricing of contingent claims", Journal of Computational Finance, 18, 27-58.

2. Chacon, J. and Duon, T. (2015), "Efficient recursive algorithms for functionals based on higher order derivatives of the multivariate Gaussian density", Statistics and Computing, Sep 2015, Volume 25.

Joint work with Hideharu Funahashi (Mizuho Securities Co., Ltd.).

December 10, 17:05-17:50 Special invited talk

Electronic Market Making: Potential Profits and Research Opportunities

Stanley R. Pliska

University of Illinois at Chicago

In recent years electronic market making of stocks, options, and other financial instruments has replaced open outcry by people in trading pits on the floor of an exchange. This has led to the implementation of real-time algorithms on computers which, in order to maximize the profits of the trading firms, trade automatically at high frequencies. Ideally things run smoothly, but there are risks, as evidenced by what happened on May 6, 2010, when the Dow Jones Industrial Average plunged by more than 8% in about an hour. This talk will give an overview of electronic market making and provide an indication of some of the algorithms and methods used by a trading firm in Chicago. Since profit optimization is the obvious objective of such a firm, so is mathematical optimization. But classical optimization where there is a well-defined, underlying stochastic process is inappropriate, so one must turn to things like machine learning and maybe even artificial intelligence. Hence there are rich opportunities for creative, mathematical research.

Plenary speech December 11, 10:00-10:45

Econometrics with Privacy Preservation

Ning Cai

Hong Kong University of Science and Technology

Many data are sensitive in areas such as finance, economics, and other social sciences. We propose an ER (encryption and recovery) algorithm that allows a central administration to do statistical inference based on the encrypted data, while still preserving each party's privacy. The algorithm works even for a colluding majority in the presence of cyber attack. Essentially, we establish a general framework for statistical inferences with privacy preservation, which can be viewed as a sensitive data based counterpart of traditional statistical inferences assuming availability of the data. We demonstrate the applications of our algorithm to linear regression, logistic regression, maximum likelihood estimation, the method of moments, and estimation of empirical distributions. Moreover, our algorithm can help to address another practically significant issue – privacy preservation for statistical inferences when data are allocated to different parties which, however, are unwilling to share their own data with others. Finally, we provide two extensions of the applications of our algorithm, including the combination of our algorithm and Fourier transforms and the development of a modified root-finding method for recovering quantiles with privacy preservation.

Joint work with Steven Kou (Boston University).

December 11, 10:45-11:30 Plenary speech

Understanding Crypto Currencies

Wolfgang Karl Härdle

Humboldt-Universität zu Berlin

Data is value - no doubt about that. But why do Cryptocurrencies (CCs) polarize in such a harsh way and thus what is the reason for the rise of interest in them? We will take a look at the basic principles and mechanisms which make CCs work and discuss about past and current developments within the CC community. By using CRIX data, the Cryptocurrency IndeX, we can provide expressive visualizations to show some of the remarkable differences in regards to traditional assets, as well as amongst CCs themselves. We provide an overview of possible research areas, which may well benefit from the very recent preliminary work done. Not only can this lead to a new golden age for modern finance as now 24/7 data is available for use, but also other well different disciplines have the possibility to form synergies and do research on the problems which lay ahead of us when talking about CC markets as also the CC constructions themselves are well interconnected to other networks.

Tutorial talk December 11, 13:00-14:30

Blocks, Transactions and Prices

Rostislav Berezovskiy

FinForge cryptolab

I'll tell about the basics of blockchain, give an overview of different approaches to organize the distributed ledger in cases of public and private blockchains. In blockchain there are two important sources of data: cryptocurrency prices from exchanges and transactions history which shows the real day to day user activity. I'll tell about results one can get by looking at these sources separately and combined.

December 11, 14:50-15:15　Contributed talk (Japanese language session)

金融ネットワークモデルをベースとしたビジネスゲームとファシリテーション支援枠組みの提案

菊地剛正

慶應義塾大学

本発表では，金融ネットワークモデルをベースとしたビジネスゲームを作成するとともに，当該ゲーミングにおいてファシリテーションを支援する枠組みを提案する．著者らは，金融機関の運用・調達行動及び金融規制を表現したシステミック・リスクのシミュレーションモデルを提案している．当該モデルは，ROE 重視の風潮や VaR によるリスク管理が金融機関の投融資行動を規定し，バランスシートの変動幅を拡大させ，連鎖破綻の可能性を高めたとする先行研究を参照し，エージェントベースモデルにより構築したものである．本発表では，エージェントの意思決定の一部である金融機関の投資行動を人間が代替できるよう拡張し，コンピュータを利用する形式のビジネスゲームを作成する．また，ゲーミングでは，一般にファシリテーションの重要性が論じられている．一方で，ゲーミングの結果からプレイヤの判断・行動を分析・評価するための方法論の確立は必ずしも進んでいない．そこで，プレイヤの判断・行動の分析・評価を支援する枠組みを提案する．具体的には，シミュレーション分析の方法論を取り入れる：1) エージェントベースモデルによるシミュレーション・ログの内容を類型化する，2) 人間によるプレイ・ログを，類型化した結果上にマッピングし，プレイヤのログを位置づける．このようにして，シナリオ・シミュレーションパスの全体像におけるプレイヤの位置付けを可視化し，同時に「あり得た」他の結果を提示することにより，プレイヤ及びファシリテータ双方に対して，有用な情報を提供する．本発表では，当該支援枠組みに係るフィージビリティの確認を行う．

田中祐史（東京工業大学），國上真章（東京工業大学），山田隆志（山口大学），高橋大志（慶應義塾大学），寺野隆雄（東京工業大学）との共同研究．

Contributed talk (Japanese language session)　December 11, 15:15-15:40

企業間の類似性と M&A: テキスト分析アプローチ

小室幸人

東京工業大学

本研究は、どのような 2 つの会社が M&A による統合や支配関係を構築しているかについて、有価証券報告書のテキストデータを用いて分析している。M&A の主たる動機が規模の経済性、範囲の経済性にあるとすれば、企業間の事業類似性、技術類似性は M&A に結びつく可能性が高い。一方で、M&A を通した新たな経営資源の獲得が価値創出の源泉と考えると、ほぼ同じ経営資源を持つ企業同士が統合しても、規模の経済性以外の新たな価値創出に結びつかない可能性が高い。本研究は、2014 年 4 月から 2018 年 3 月に発表された日本の上場企業間における M&A316 件を対象に、有価証券報告書 の「事業の内容」と「研究開発活動」を使用して企業間の事業類似性、技術類似性を計測し、それらの類似性が M&A の発生確率に与える影響を検証している。分析の結果、いずれの類似性指標も M&A の発生に正の影響を持つこと、ただし類似度が一定の水準を超えて高まると逆に M&A の発生を抑制することを発見した。一方で、類似度と M&A 発表時の株価効果の間には有意な関係は確認出来ない。 2 つの企業は、M&A において 2 社間の類似性を判断材料にしているが、株式市場は 2 社間の類似性が M&A による価値創出の可能性を高めるとは評価していないことを示唆する。しかし、株価効果事態はプラスであることから、企業の判断が株主価値に反するものとは言えないことに注意が必要である。本研究は、筆者の知りうる限りにおいて、企業行動の発生確率の推定に有価証券報告書のテキスト情報が情報価値を持つことを実証的に示した国内最初の研究である。M&A の発生予測モデルにおいて、類似性を変数に含めることでの説明力の上昇は顕著であり、有価証券報告書のテキスト情報の価値を示唆する。一方で、本研究で使用した類似性は、その経済的意味が曖昧であり、さらなる改善が課題である。

池田直史（東京工業大学），井上光太郎（東京工業大学）との共同研究.

December 11, 15:40-16:05　Contributed talk (Japanese language session)

Analyzing the relationship between the synergy effect and divestment in M&A through the mixture model

松本裕介

慶應義塾大学

To keep up with rapid changes in the business environment, Japanese companies have required to conduct business restructuring in recent years. Formerly, it was a passive state for them to divest one of their business through M&A. Currently, more and more Japanese companies have been conscious of that divestment through M&A is one of the positive strategies. In this paper, we analyze the relationship between the synergy effect of multi-business companies and M&A such as business transfer. The purpose of this study is to identify influence factors on making decision to sell a business, focusing on divestment through M&A. We choose companies listed on the first section of the Tokyo Stock Exchange as our target. The term for analysis runs from 2002 to 2016. In estimation of the synergy effect, we compare the difference between pure-play companies and multi-business companies, by recognizing to which industry each segment belongs. Considering the discussion about the drawback of existing industrial classification, in this study, we classify companies through the mixture model, one of the clustering methods. In addition to synergy effect calculated like above, we conduct logit analysis using the panel data after adding variables such as EBITDA/Sales and Debt/Asset. The result of this analysis is as followed: First, either the higher the ratio of debt was, or the lower the synergy effect was, the companies tended to divest through M&A. Second, it implies that companies faced with the deteriorating performance managed to sell out their business. Detailed analysis is planned for the future task.

菅愛子（慶應義塾大学），高橋大志（慶應義塾大学）との共同研究.

Contributed talk (Japanese language session)　December 11, 16:25-16:50

有価証券報告書のテキストマイニングによる株式のリスクファクター分析

佐藤隆清

東京工業大学

企業ファイナンスの分野においても Loughran and McDonald (2016) のサーベイが示すように、企業開示データを用いたテキスト分析が盛んになりつつある。しかし、日本では、これまで有価証券報告書のテキスト情報が、市場におけるリスク認識に対して説明力を持つかを直接検証した研究はない。そこで本稿は企業のリスク要因の特定におけるテキストデータ分析の有用性を検証する。具体的には、有価証券報告書のテキストデータが翌期の株式のリスクに対してどの程度有用な情報を提供するのかを検証した。分析にあたって、有価証券報告書の「事業等のリスク」の記述に対してテキスト分析を用いた。本稿では企業ごとの単語の出現回数を抽出し、抽出した単語を、リスクのカテゴリー別に分類した。分析には出現した総単語数の自然対数と総リスク用語の自然対数、それぞれのリスクに関する用語の出現確率を用いた。検証の結果、「事業等のリスク」の記述から得られた市場リスク・個別リスクに関する用語の出現確率が、CAPM およびファーマ・フレンチの 3 ファクターモデルの下での次期の株価におけるそれぞれのリスク指標と正に相関することが明らかになった。これは、有価証券報告書のテキストデータに、株式のリスクを推定する上で有効な情報を持つことを示唆する。また、同様にファーマとフレンチの 3 ファクターモデルにおけるサイズプレミアムとバリュープレミアムは、それぞれ市場リスクとは異なるリスク要因であり、企業の財務リスクを反映したものであることをテキスト分析から確認した。本稿で有効な結果が得られたことから、今回作成した辞書は企業開示文書におけるリスク計測のための有用な辞書と考えられ、これも本稿の貢献の一つである。

池田直史（東京工業大学），井上光太郎（東京工業大学）との共同研究

December 11, 16:50-17:15　Contributed talk (Japanese language session)

マルチアセット市場におけるスペシフィック・リターンに着目した投資戦略

伊藤彰朗

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株式・債券・為替市場は、各資産クラス内だけでなく、資産クラス間においても互いに影響しながら変動する。すなわち、資産クラスの内外それぞれに共通の変動要因 (ファクター)、すなわち、特定の資産のリターンのうち、他の資産クラスの変動で説明可能な部分が存在すると考えられる。本稿では、1. 資産クラス内での共通のファクターを除いた残差部分 (スペシフィック・リターン)、2. 資産クラス間でのスペシフィック・リターンのそれぞれを、部分最小二乗回帰 (PLS) を用いて抽出する。そして、当該スペシフィック・リターンが時系列および、クロスセクションの両面で各市場の将来の価格変動に対し説明力を持ち、投資戦略に応用できることを実証する。これは株式市場におけるペア・トレード戦略の資産クラスの拡張であり、資産クラス問わず広く知られている、モメンタムやリバーサル効果のスペシフィック・リターンへの拡張でもある。

中川慧（野村アセットマネジメント株式会社）との共同研究.