GIUSEPPE BRANDI

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EDUCATION

10/2018 - 09/2022	**Ph.D. in Applied Mathematics**, *King's College London, London*
Grade:	*Pass with no corrections*
Ph.D. thesis:	Multiscaling in complex systems data and their multidimensional analysis
Supervisor:	*Tiziana Di Matteo, Alessia Annibale*
Thesis committee:	*Elsa Arcaute,Andrea Gabrielli*

09/2014 - 05/2018	**Ph.D. in Economics**, *LUISS, Rome*
Grade:	*Excellent cum laude*
Ph.D. thesis:	*Decompose et Impera*: Tensor Methods in High-dimensional Data
Supervisor:	*Giuseppe Ragusa*
Thesis committee:	*Animashree Anandkumar, Matthew Harding, Marco Lippi*

09/2013 - 06/2014	**Postgraduate Master in Finance**, *Collegio Carlo Alberto, Turin*
Grade:	*A*

10/2012 - 02/2014	**MSc in Money and Finance**, *University of Ljubljana, Ljubljana*
Grade:	*10/10*
Supervisor:	*Igor Masten*

11/2011 - 02/2014	**MSc in Finance**, *University of Siena, Siena*
Grade:	*110/110, cum laude*
Master thesis:	A Bayesian Markov Regime Switching GARCH Model for Exchange Rates and Interest Rates
Supervisor:	*Roberto Renò*

10/2008 - 10/2011	**BSc in Business Administration**, *University of Perugia, Perugia*
Grade:	*102/110*
Degree thesis:	The Mean-Variance Approach in Portfolio Theory
Supervisor:	*Roberto Celentano*

HONORS AND SCHOLARSHIPS

2023	*King's Outstanding Thesis Award*, Department of Mathematics, King's College London
2018	*Doctoral Scholarship*, Ph.D. in Applied Mathematics, King's College London
2014	*Doctoral Scholarship*, Ph.D. in Economics, LUISS
2013	*INPS Master J Scholarship*, Master in Finance, Collegio Carlo Alberto
2012	*Double Degree Program* in the MSc in Money and Finance at University of Ljubljana, University of Siena

RESEARCH INTEREST

FIELD	SUBFIELD
Econometrics	Multifractal Systems, Nonparametric Modelling, Time Series, Volatility modeling
Statistics	Tensor Methods, Likelihood-free Methods, Statistical Learning
Network	Interbank Networks, Dynamic Networks, Network Forecasting
Finance	Systemic Risk, Financial Contagion, Portfolio Analysis, Climate Finance

During my research career, I developed rather diverse research interests at the interconnection of Data Science, Applied Mathematics and Statistics. In particular, the areas where I mostly contributed are: Tensor methods in Economics and Finance, multiscaling time series, and systemic risk with the use of complex networks. My contributions and future plans in the medium and long terms are summarized below:

Tensor methods: In the last few decades, multidimensional data analysis has become a relevant topic of study in the Data Science literature. I contributed to the literature by developing a regression type of model in which the variables can be tensor structured and by analysing multidimensional data structures through various tensor decompositions. My current and future plan is to continue analysing those multidimensional data in financial applications in order to produce better models for risk management and forecasting. In particular, I am interested in developing and analysing portfolios in which tensor cumulants are incorporated in the optimization problem, which can help the financial community to properly address higher-order risk features in their investment strategies. Further, I would like to produce a synthetic tool that maps the dependencies between assets in the market using higher-order statistics in combination with tensor factorization.

Multiscaling time series: Scaling analysis of stochastic time series has been analysed for almost 60 years. However, we still need to learn a lot from what generates scaling and multiscaling behaviour in time series. Several works have provided some possible solutions and empirically identified key stylized facts, especially for prices and volatility time series. My contribution on the topic has been devoted to the analysis of the relation between multiscaling and dependence in stock markets, and in the elaboration of robust statistical methods in order to estimate and test scaling and multiscaling. My current work is devoted to a project related to portfolio construction and prediction. I am working toward the construction of a model which does not only maximize the expected return while minimizing the risk, but also takes into account scaling and multiscaling of the resulting portfolio which, would help improving prediction and risk assessment. A related but independent project involves the understanding of the interconnection between multifractal, multifractional and rough time series in order to produce a test able to unveil the source of multiscaling and to disentangle the effect of rough volatility to the estimation of the scaling exponent of price time series. For the future, the main question I would like to answer is: what is generating multiscaling and rough volatility? My idea is to analyse, with the help of double auction models, how several financial variables and their interconnection, both between the variables themselves and the network of economic agents, translate to multiscaling and rough volatility. This would have a huge impact on how we understand and measure risk in quantitative finance. A further project is related to the use of multiscaling features in machine learning models, especially, data assimilation, whose primary goal is to produce better forecasting outputs.

Complex networks: Interdependences between assets or any economic entities are strongly relevant for the analysis of financial markets, both for risk and performance evaluation purposes. In the last decades, we learned that an easy yet powerful way to represent these interconnections is through graphs. My contribution in the literature has been devoted to the use of stochastic models of contagion in the interbank network in order to assess the systemic risk generated by liquidity shortages. The future direction of my research related to this topic is to produce synthetic risk measures that policy-makers and market participants can use to assess economic and financial conditions. In particular, I am interested in developing, through the use of machine learning and higher-order statistics, a topological network that encapsulates partial and residual connectivity which are not accounted for in standard network analysis.

Portfolio construction and analysis: Portfolio construction is a relevant topic for its performance as most of the returns come from a good allocation of financial resources. However, markets are not static and even a good allocation would need re-balancing of the portfolio. In particular, some of the stocks can be related to regime shift of exogenous factors and this should be taken into account when making portfolio predictions. In my experimental setting, the collection of stocks can be seen as a network that is subdivided into clusters. These clusters can be found by Machine learning algorithms or taken from their industry sector. Each cluster is mostly affected by a particular external factor that drives the dynamic of intra-correlations, e.g. climate dynamics and extreme events for agriculture-related companies. These dynamics can be extrapolated by applying tensor decomposition of a large dynamic multidimensional dataset and, by studying the extracted process (both its distributional and memory aspects), forecast its dynamics. The portfolios will then be constructed in such a way that the risk of these external factors is incorporated in the asset allocation strategy.

Publications

- <u>Brandi</u>, Di Clemente, Cimini, "Epidemics of Liquidity Shortages in Interbank Markets", Physica A, 2018

- Buonocore, <u>Brandi</u>, Mantegna, Di Matteo, "On the Interplay between Multiscaling and Stocks Dependence", Quantitative Finance, 2019.

- <u>Brandi</u>, Gramatica, Di Matteo, "Unveil Stock Correlation via a New Tensor-based Decomposition Method", Journal of Computational Science, 2020.

- <u>Brandi</u>, Di Matteo, "A new Multilayer Network Construction via Tensor Learning", International Conference on Computational Science (ICCS) 2020 (refereed conference paper).

- Antoniades, <u>Brandi</u>, Magafas, Di Matteo, "The use of Scaling Properties to Detect Relevant Changes in Financial Time Series: A New Visual Warning Tool", Physica A, 2020.

- <u>Brandi</u>, Di Matteo, "Predicting Multidimensional Data via Tensor Learning", Journal of Computational Science, 2021.

- <u>Brandi</u>, Di Matteo, "Higher-order Hierarchical Spectral Clustering for Multidimensional Data", International Conference on Computational Science (ICCS) 2021 (refereed conference paper).

- <u>Brandi</u>, Di Matteo, "On the Statistics of Scaling Exponents and the Multiscaling Value at Risk", European Journal of Finance, 2021.

- Macchiati, <u>Brandi</u>, Cimini, Caldarelli, Paolotti, Di Matteo, "Systemic Liquidity Contagion in the European Interbank Market", Journal of Economic Interactions and Coordination, 2022.

- <u>Brandi</u>, Di Matteo, "Multiscaling and rough volatility: An empirical investigation", International Review of Financial Analysis, 2022.

- Biffis, <u>Brandi</u>, Lee, Snavely, "Forestry-backed Assets Design", Singapore Green Finance Centre, 2023.

Work in progress

- Biffis, Brandi, Salezadeh Nobari, Lee, Snavely, "Forestry-backed Assets Valuation".

- Biffis, Brandi, Wang, "Unsupervised model selection in climate stress testing".

- Mosley, Salezadeh Nobari, Brandi, "Sparse Disaggregation of Time-Series".

- Brandi, "Wildfires predictions via downscaled climate projections".

- Brandi, "Exploratory Analysis of Interbank Market Adjacency Tensor".

- Brandi, "Financial Maps: Network Analysis via Tensor Decomposition".

- Brandi, "Higher Order Portfolio Analysis via Factor Tensors".

- Brandi, "Financial Cross-complexity Matching".

Invited Talks

12/2020	Predicting Multidimensional Data via Tensor Learning, Imperial College
08/2017	Latent Correlation Projection via Tensor Decomposition, JP Morgan Chase
12/2016	Tensor Autoregression in Economics and Finance, Sapienza University
06/2016	Econometric Inference for Stochastic Volatility Processes: The Block-ABC Method, Collegio Carlo Alberto
06/2016	Econometric Inference for Stochastic Volatility Processes: The Block-ABC Method, Sapienza University

Contributed Talks

01/2023	Forestry-backed Assets Design, Governing the costs of wildfires 2023, London
10/2021	Higher-Order Hierarchical Spectral Clustering for Multidimensional Data, CCS 2021, Lyon
10/2021	Dynamical multiscaling in financial markets, Econophysics colloquium 2021, Lyon
06/2021	Higher-Order Hierarchical Spectral Clustering for Multidimensional Data, ICCS 2021, Online
06/2020	A New Multilayer Network Construction via Tensor Learning, ICCS 2020, Online
12/2019	Multiscaling in Finance, CFE-CMStatistics 2019, London
10/2019	Tensor Autoregression in Economics and Finance, 2019, CCS 2019, Singapore
07/2019	Multiscaling in Finance, Lipari school 2019, Lipari
06/2019	The Statistics of Hurst, WEHIA 2019, City University, London
09/2017	Latent Financial Networks Projection via Correlation Tensor Decomposition (poster), RSS 2017, UoG
07/2017	Latent Financial Networks Projection via Correlation Tensor Decomposition, YSM 2017, Keele University
07/2017	Tensor Autoregression in Economics and Finance (poster),YSM 2017, Keele University
07/2017	Latent Financial Networks Projection via Correlation Tensor Decomposition, SDS 2017, Imperial College
06/2017	Tensor Autoregression in Economics and Finance, EcoSta 2017, Hong Kong
05/2017	Tensor Decomposition for Financial Network Analysis, LUISS
12/2016	Tensor Autoregression in Economics and Finance, CMStatistics 2016, Seville
11/2016	Tensor Autoregression in Economics and Finance, LUISS
04/2016	Econometric Inference for Stochastic Volatility Processes: The Block-ABC Method, LUISS

Professional Experience

03/2023 - present	**Research Consultant in Climate risk analitycs in Finance**, *Standard Chartered*
01/2022 - 04/2023	**Research Consultant in forestry asset-baked security analitycs**, *Terraformation*
10/2019 - 12/2019	**Teaching Assistant in Statistics for Finance**, *King's College London, London*
10/2019 - 12/2019	**Teaching Assistant in Statistics for Data Analysis**, *King's College London, London*
06/2018 - 07/2018	**Lecturer in Econometrics (graduate preparatory course)**, *LUISS, Rome*
02/2018 - 09/2018	**Teaching Assistant in Asset Pricing**, *LUISS, Rome*
11/2017 - 03/2018	**Scientific Tutor in the Master in Big Data**, *LUISS Business school, Rome*
10/2017 - 03/2018	**Research Assistant in Macroeconometrics for Professor Benigno**, *LUISS, Rome*
09/2017 - 09/2018	**Teaching Assistant in Empirical Finance**, *LUISS, Rome*
09/2017 - 12/2017	**Lecturer in MathLab: Data Analysis with Stata**, *LUISS (MEEG), Rome*
09/2017 - 12/2017	**Lecturer in Statistics**, *LUISS Business school (MACOFIN), Rome*
09/2017 - 12/2017	**Lecturer in Statistics and Econometrics**, *LUISS Business school (MMT), Rome*
09/2017 - 12/2017	**Lecturer in Matlab coding**, *LUISS LOFT, Rome*
07/2017 - 07/2018	**Lecturer in Econometrics for Big Data**, *LUISS Business school (MABDA), Rome*
06/2017 - 07/2017	**Lecturer in Econometrics (undergraduate preparatory course)**, *LUISS, Rome*
05/2017 - 07/2017	**Lecturer in Statistics (MBA preparatory course)**, *LUISS Business school, Rome*
02/2017 - 06/2017	**Lecturer in Machine Learning with Matlab**, *LUISS LOFT, Rome*

01/2017 - 09/2018	**Teaching Assistant in Capital Markets**, *LUISS, Rome*
02/2016 - 09/2017	**Teaching Assistant in Statistics and Econometrics**, *LUISS, Rome*
08/2015 - 01/2016	**Research Assistant**, *Oxford Economics, Rome* - Econometric Models and the Role of Econophysics in Economics
07/2015 - 06/2016	**University tutor**, *LUISS, Rome*
03/2015 - 08/2015	**Research Assistant**, *ASSONIME, Rome* - European Economy: Macroeconomic Implications of the Eurozone Crisis - Italian Economy: Long-term Evolution of Employment and Productivity

ADDITIONAL GRADUATE TRAINING

09/2016	**Summer School in Econometrics**, *Centro Interuniversitario di Econometria, Perugia* - Advanced Bayesian Econometrics, *R. Casarin, M. Ciccarelli, F. Ravazzolo*
08/2016	**Summer School in Applied Bayesian Statistics**, *CNR-IMATI Milano & Università Cattolica, Como* - Bayes, Big Data and the Internet, *S. Scott*
07/2016	**Summer School in Mathematical Methods for High-Dimensional Data Analysis**, *TUM, Munich* - Topological Time Series Analysis, *J. Perea* - Streaming and Sketching Algorithms, *J. Nelson* - Topological Descriptors for Geometric Data, *Steve Oudot* - Optimal Stochastic Regularization for Large Scale Machine Learning, *L. Rosasco*
07/2016	**Summer School in Financial Econometrics**, *Society of Financial Econometrics, Bruxelles* -Noncausal Autoregressive Process, *C. Gourieroux , J-M. Zakoian*
07/2016	**Summer School in Econometrics**, *Centro Interuniversitario di Econometria, Perugia* - Big Data and Machine Learning, *M. Harding, A. Anandkumar*
09/2015	**Summer School of Mathematics for Economics and Social Sciences**, *Scuola Normale Superiore* - Financial Economics, *G. Bottazzi, P. Dindo*
08/2015	**Summer School in Mathematics**, *Scuola Matematica Interuniversitaria (SMI), Perugia* - Game Theory, *R. Lucchetti* - Mathematical Statistics, *L. Goldsteint, Y. Rinott*
06/2015	**Summer School in Econometrics**, *Centro Interuniversitario di Econometria, Perugia* - "Big Data" and High-Dimensional Econometric Models, *V. Chernozhukov, C. Hansen*
08/2014	**Summer School in Mathematics**, *Scuola Matematica Interuniversitaria (SMI), Perugia* - Stochastic Processes, *W. Woess, P. Baldi* - Mathematical Statistics, *S. Zabell*
06/2014	**Summer School in Applied Bayesian Statistics**, *CNR-IMATI Milano & Università Cattolica, Como* - Applied Bayesian Nonparametrics, *M. Jordan, F. Caron*
09/2013	**Summer School in Bayesian Econometrics**, *Centro Interuniversitario di Econometria, Perugia* - Bayesian Methods for Economics and Finance, *R. Casarin, A. Mira, M. Ciccarelli, G. Carmeci*
07/2013	**Summer School in Econometrics**, *Centro Interuniversitario di Econometria, Perugia* - Bayesian Macroeconometrics, *M. Del Negro* - Modelling and Forecasting Macroeconomic Series, *V. Corradi*

07/2013 **Summer School in Macroeconometrics**, *Barcelona GSE, Barcelona*
  - Bayesian Vector Autoregressions and Small Sample Corrections in VARs, *A. Marcet, M. Jarocinski*
  - Empirical Time Series Methods for Macroeconomic Analysis, *L. Gambetti*

Referee service

Finance: Quantitative Finance, Risk, The Journal of Network Theory in Finance
Interdisciplinary: Physica A, Chaos, Solitons & Fractals, Journal of Statistical Mechanics

Skills

LANGUAGES
Italian   Native proficiency
English   Professional working proficiency

COMPUTER
Office   MS Office, LaTeX
Programming   MatLab, R, Python
Econometrics   EViews, Stata, JMulTi

Other Information

Memberships: Complex System Society, Royal Statistical Society, Society of Financial Econometrics
Entertainment: Cinema, Theatre, Books, Classical and Orchestral music
Sport: Football, Tennis