QuantMinds

Welcome to QuantMinds International 2024

The official event guide

QuantMinds

Contents

Everything you need to know about QuantMinds International in one place

What's on this week?

See our agenda overview and plan your days ahead.

Meet our sponsors

QuantMinds wouldn't be complete without our partners. Discover their latest innovations and prepare to meet them on site.

Next in quant

Meet the future innovators and leaders of quant finance

Level up your skills

Explore the workshops running at QuantMinds International. (Some available to pre-bookings only.)

Dive into the latest research

Our editor's picks will help you choose.

On the mainstage

On the derivatives stream

On the risk stream

In the buy-side boardroom

On the computation, data & innovation stream

On the quant tech and trading stream

BONUS CHAPTER

JD Opdyke, Chief Analytics Officer & Partner at Sachs Capital Group Asset Management, LLC, shares a chapter of his forthcoming book

Read now

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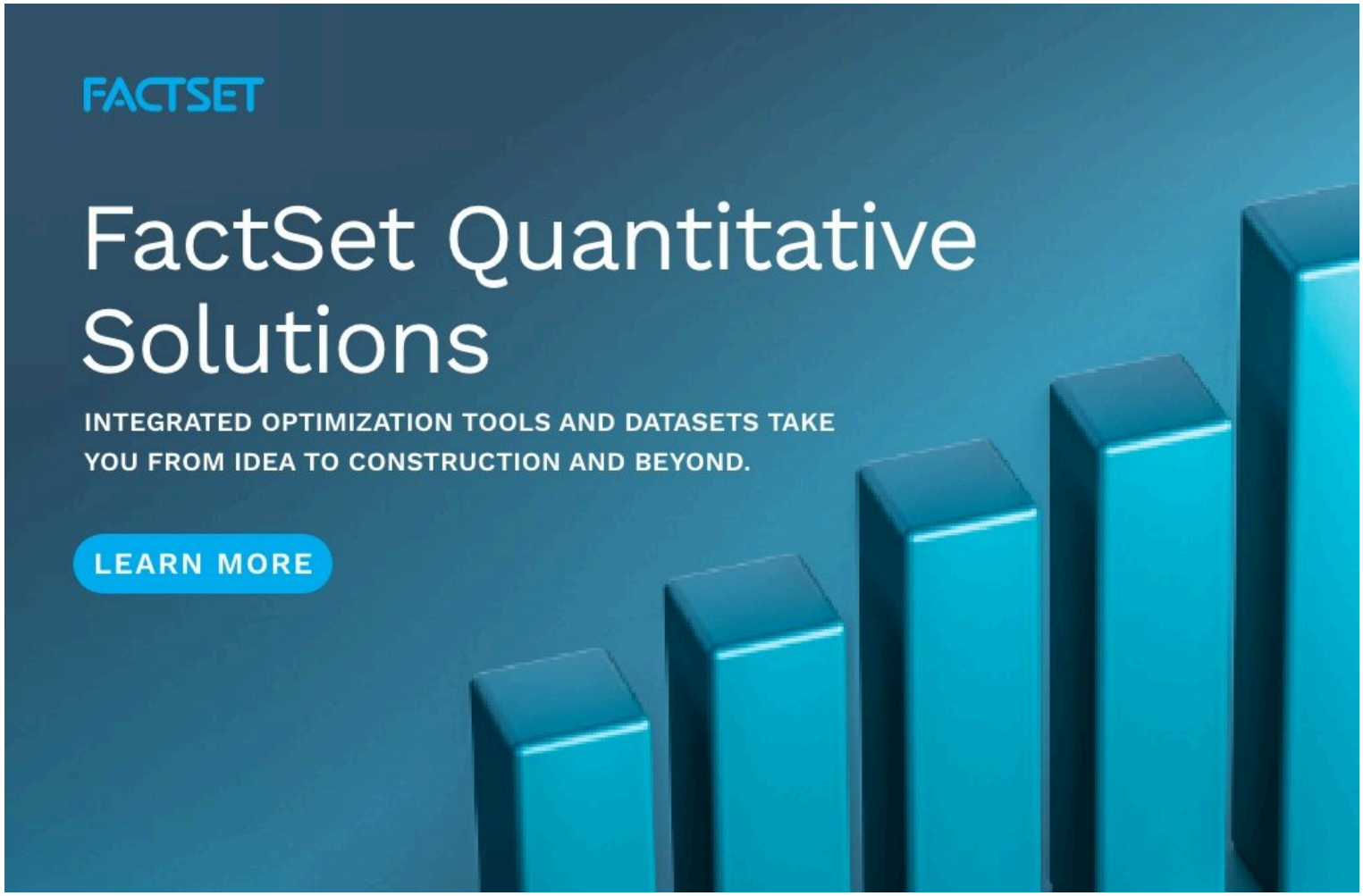

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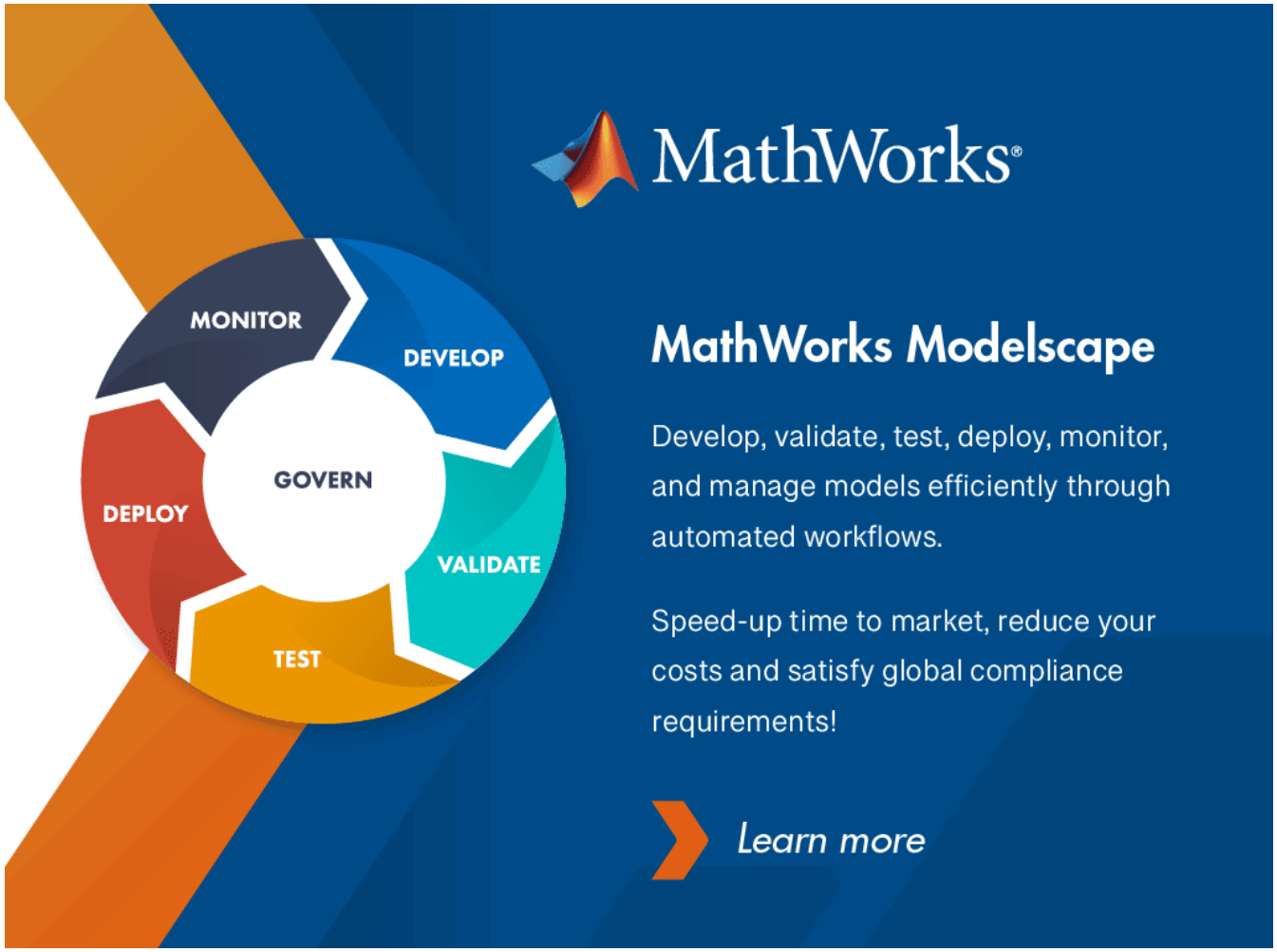
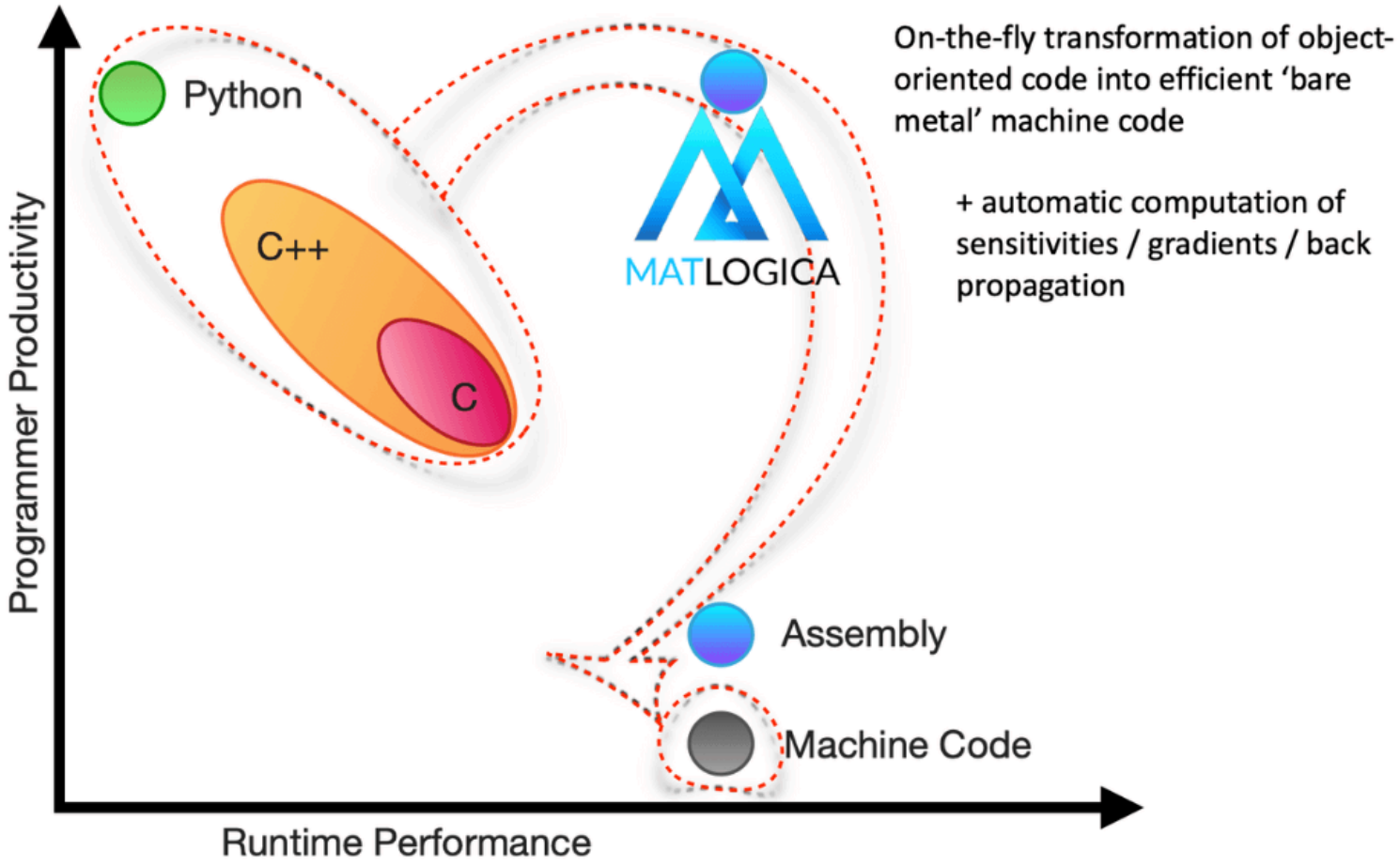


Our Talent Partner: Selby Jennings

Our Exhibitor: Matlogica



QuantMinds

What's on this week?

The agenda at a glance

Mon 18 Nov

On this Summit Day, we focus on LLMs, machine learning, investment innovations, and volatility modelling throughout the day and conclude with discussion roundtables over drinks.

Quant Invest Summit
All day, Cutty Sark 1 & 2

LLMs & Advanced ML Summit
All day, Arora 12 & 15

QuantMinds Hackathon
All day, Riverview 2 & 3

Networking drinks & roundtable discussions
From 18:00, Expo hall & Riverview Foyer

Rough Volatility Workshop
All day, Arora 13 & 16

Machine Learning in Finance Workshop
All day, Arcadia 1 & 2

Tue 19 Nov

The main conference kickstarts with discussions around AI, green finance, and regulations. After lunch, choose your own specialist conference stream!

QuantMinds Plenary
All morning, Arora 12, 13, 15 & 16

PhD Poster Sessions
All day, Arora Foyer

Specialist Streams
From 14:00
Derivatives Stream (Arora 12 & 15)
Risk Stream (Arcadia 1 & 2)
Computation, Data, and Innovation Stream (Arora 13 & 16)

Networking drinks & roundtable discussions
From 18:00, Expo hall & Riverview Foyer

CompatibL Workshop
11:30-13:00, Arcadia 1 & 2

Buy-side Boardroom
From 14:00, Cutty Sark 1 & 2

Wed 20 Nov

On day 2 of QuantMinds International, we continue discussions around the various quant subject matters, and celebrate the future leaders of the sector.

QuantMinds Plenary
Morning, Arora 12, 13, 15 & 16

Buy-side Boardroom
From 14:00, Cutty Sark 1 & 2

Specialist Streams
From 11:30 - 18:00
Derivatives Stream (Arora 12 & 15)
Risk Stream (Arcadia 1 & 2)
Computation, Data, and Innovation Stream (Arora 13 & 16)

Women in Quant Finance
From 13:00, Riverview Foyer
Lunch roundtable discussion - open to all!

Awards ceremonies, networking drinks & roundtable discussions
From 18:00, Arora Foyer, expo hall & Riverview Foyer

Thu 21 Nov

We conclude QuantMinds International with more in-depth specialist presentations and mini workshops.

Specialist Streams
All day
Derivatives Stream (Arora 12 & 15)
Risk Stream (Arcadia 1 & 2)

Quantum computing mini workshop
From 09:00 - 11:00, Arora 13 & 16

Quant Tech and Trading Stream
From 11:30, Arora 13 & 16

Latest in volatility mini workshop
From 09:00 - 13:00, Cutty Sark 1 & 2

QuantMinds

FutureQuantMinds

The programme at QuantMinds International is made to include and celebrate the next generation of quant innovators and leaders.

QuantMinds PhD Poster Programme

After months of deliberation, our advisory board has whittled the entries down to 12 outstanding posters - all displayed at QuantMinds International! Who will be the recipients of the *QuantMinds Peter Carr Memorial award*? You decide!

When?

Vote by Wed 16:00, winners are anounced on Wed at 18:00

Where?

Arora Foyer

QuantMinds Hackathon

Held in partnership with CompatibL, the hackathon is a chance to demonstrate and hone your skills and learn new modelling techniques. Participants' work will be judged and prizes will be given out to top scoring teams/ individuals, relative to the category average.

When?

Monday all day, winners are anounced on Wed at 18:00 in the Arora Foyer

Where?

Riverview 2 & 3

Women in Quant Lunch

Open to everyone, this roundtable is designed to make discussions around diversity and inclusion more accessible to everyone. Led by Diana Ribeiro, Quant Director, Citi, this is your opportunity to understand how you can make your team better.

When?

Wed 13:00-14:00

Where?

Riverview Foyer

QuantMinds

QuantMinds workshops

Led by SMEs, this is your chance to get up to speed with cutting edge techniques.

Rough Volatility Workshop

Hone your skills and get the latest on:

- Econometrics and forecasting
- Rough volatility models (under Q)
- Affine models and their microstructural foundation
- Computation

When?

Mon 18 Nov, pre-booking essential

Where?

Arora 13 & 16

Led by Jim Gatheral

Baruch College, CUNY

Machine Learning in Finance Workshop

Get to grips with:

- Elements of deep learning
- Deep learning for pricing and hedging
- Deep calibration
- Generative models

When?

Mon 18 Nov, pre-booking essential

Where?

Arcadia 1 & 2

Led by Blanka Horvath

University of Oxford

And Mikko Pakkanen

Imperial College

Mini workshops

Available on a first come first served basis

Practical techniques for building reliable LLM-based workflows

Led by Alexander Sokol, CompatibL, this session will focus on practical techniques for building reliable and effective LLM-based workflows for extracting accurate information from natural language documents or unstructured data.

When?
Tue 11:30-13:00

Where?
Arcadia 1 & 2

Quantum computing

Led by Davide Venturelli, USRA, this workshop will show the capabilities of quantum computing in finance and its impact on machine learning techniques.

When?
Thu 08:55-11:00

Where?
Arora 13 & 16

Latest in volatility modelling

Led by Julien Guyon, École nationale des ponts et chaussées, this mini workshop explores stochastic volatility and addresses the joint S&P 500/VIX smile calibration challenge.

When?
Thu 08:55-13:00

Where?
Cutty Sark 1 & 2

QuantMinds

QuantMinds summits

We start the week with specialist streams.
Don't forget to book in advance!

Quant Invest Summit

People power: Seeking alpha through workplace inclusion

This study offers an innovative approach to addressing the challenges of measuring workplace inclusion culture and provides concrete evidence of its impact on innovation, financial performance and stock returns.

Presented by

Andreas Theodoulou, Data Scientist, Citi

When & where?

Mon 18 Nov, 10:00, in Cutty Sark 1 & 2

Investors' concerns and the pricing of physical climate risk

We study how the global equity markets price physical climate risk associated with tropical cyclones.

Presented by

Karen Huynh, Research Analyst, Amundi

When & where?

Mon 18 Nov, 13:30, in Cutty Sark 1 & 2

Interpretable supervised portfolio

The "Interpretable Supervised Portfolio" framework is an innovative approach to asset allocation by leveraging the RuleFit algorithm to engineer optimal portfolio weights directly, prioritizing optimization before prediction.

Presented by

Thomas Raffinot, Head of Quant Investment Signals, AXA Investment Managers

When & where?

Mon 18 Nov, 15:30, in Cutty Sark 1 & 2

LLMs and Advanced ML Summit

Whither AI?

In this talk, we will explore the current state of the art in AI applications, discuss the challenges of AI adoption in the enterprise, and talk about the risks and future directions of AI development.

Presented by

Gary Kazantsev, Head of Quant Technology Strategy, Bloomberg

When & where?

Mon 18 Nov, 10:00, Arora 12 & 15

How to break the bank?

Systematic vulnerability identification using machine learning

This paper introduces a new quantitative toolkit for (reverse) stress testing of the Banking Book -- as required by EBA IRRBB regulations and the Basel Framework.

Presented by

Eric Schaanning, Group Head of Market and Valuation Risk Management, Nordea

When & where?

Mon 18 Nov, 11:00, Arora 12 & 15

Graph neural networks for time series prediction

This talk explores the application of GNNs to financial time series forecasting by representing assets and their interdependencies as dynamic graphs.

Presented by

Richard Turner, Managing Director, Currency Management, Mesirow Financial

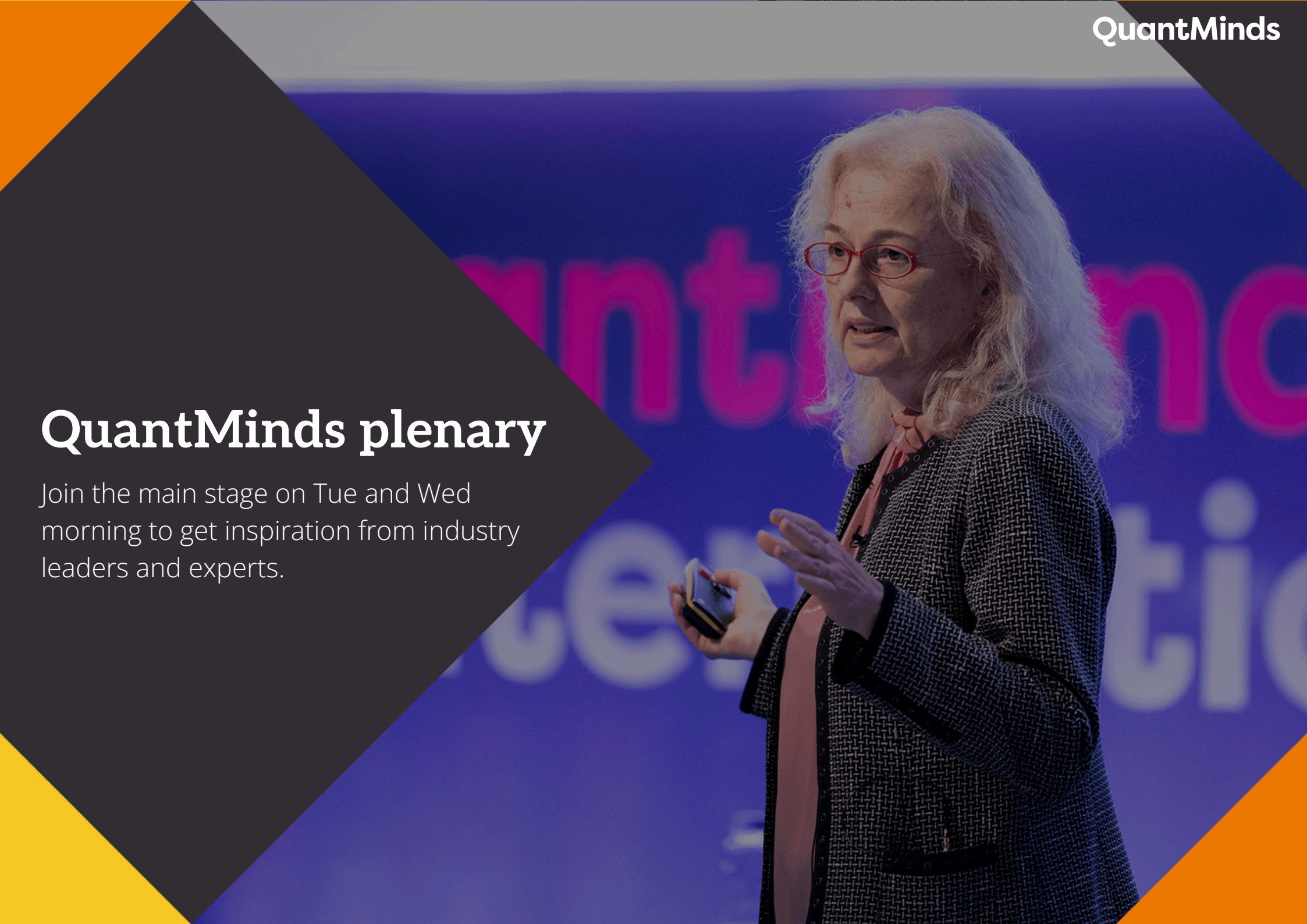
When & where?

Mon 18 Nov, 17:20, Arora 12 & 15

QuantMinds

QuantMinds plenary

Join the main stage on Tue and Wed morning to get inspiration from industry leaders and experts.



Panel discussions

Explore the state of quant finance with practitioners

From GenAI to LLMs: How are businesses integrating different aspects of the world of AI into practice

What are the strategic developments in large language models in the current industry? How is GenAI specifically being used in top institutions? Perspectives from investment banking and fund management.

When & where?

Tue 19 Nov, 08:50, Arora 12, 13, 15 & 16

Unlocking the power of alternative data in finance: New data sources, models, strategies

Modelling techniques and investment strategies for better decision-making and improved investment performance.

When & where?

Wed 20 Nov, 08:50, Arora 12, 13, 15 & 16

Women in quant: A structured analysis

The financial and strategic implications of the lack of diversity in the workplace and the wider industry

When & where?

Wed 20 Nov, 09:55, Arora 12, 13, 15 & 16

Get inspired

Meet expertsfrom different fields and see what they have to say about innovation, data, and human creativity.

Long-term project management for futuristic technologies

How can institutions plan for long term technological investments and decisions? What is the necessary infrastructure required for this? Where is quantum computing and other similar technologies today?

Presented by

Joachim Mnich, Director for Research and Computing, CERN

When & where?

Tue 19 Nov, 10:00, Arora 12, 13, 15 & 16

Humans and data

Roma Agrawal, engineer, author and broadcaster, looks at historical examples of the importance of human creativity and instinct in dealing with large amounts of data. She will also share stories of how time is a human-made construct and why we should reframe our understanding of it.

Presented by

Roma Agrawal MBE, Structural Engineer, Author and Broadcaster, Roma the Engineer

When & where?

Tue 19 Nov, 10:00, Arora 12, 13, 15 & 16

QuantMinds

Select your subject

This year our specialist streams are:
Derivatives | Risk | Buy-side boardroom |
Computation, data and innovation |
Quant tech and trading

Derivatives

The adaptive curve evolution model for interest & FX rates

The ACE short rate model is the first to combine all of the most desirable analytical properties in one interest rate framework. Recently, it has been extended the model to cover the rates of multiple currencies, as well as their FX spot and forward rates.

Presented by

Matthias Heymann, Former Market Data Scientist, Millennium

When and where?

Tue 19 Nov, 15:50, Arora 12 & 15

Fast option pricing with discrete dividends

We consider modern numerical methods for performant pricing of European, Bermudan, and American options when the underlying asset pays discrete dividends.

Presented by

Leif Andersen, Global Co-Head Of Quantitative Strategies Group, Bank of America

When and where?

Wed 20 Nov, 14:00, Arora 12 & 15

Volatility shape-shifters: Arbitrage-free transformations of implied volatility surfaces

We introduce a framework for generating arbitrage-free transformations of an implied volatility surface based on optimal transport maps between suitable distributions.

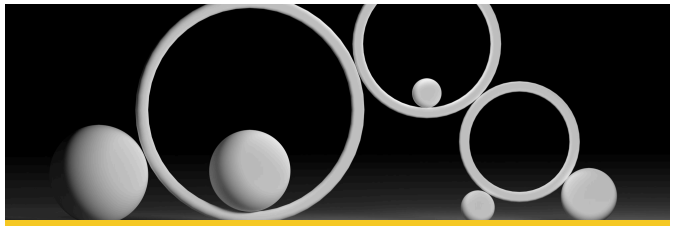
Presented by

Valer Zetocha, Senior Quantitative Analyst, Julius Baer

When and where?

Thu 21 Nov, 12:20, Arora 12 & 15

Risk



Financial system wide liquidity risks and related (experimental) stress testing

- Recent episodes and basic concepts
- From entity to system stress testing
- Banking system applications
- Financial system applications

Presented by

Jérôme Henry, Principal Adviser – DG Macroprudential Policy and Financial Stability, European Central Bank

When and where?

Tue 19 Nov, 16:20, Arcadia 1 & 2

CCR Stress Testing, WWR and Leverage: A Monte Carlo simulation based framework

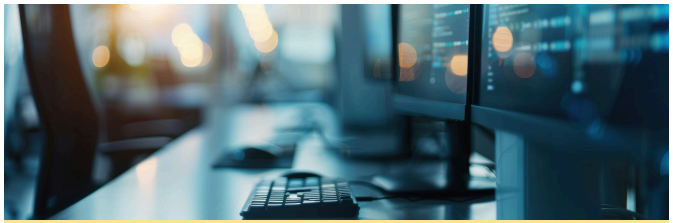
We build up on recent analytical progress and we show how a suitable combination of Gaussian copulas and mixture models technics can be used to realise a flexible Monte Carlo based CCR stress testing framework.

Presented by

Fabrizio Anfuso, Senior Technical Specialist, Bank of England

When and where?

Wed 20 Nov, 14:40, Arcadia 1 & 2



Computing the impact of central clearing on systemic risk - a generative approach

Focusing on central clearing, we model the financial system as a multigraph of trade and risk relations among banks. We then study the impact of central clearing by a priori estimates in the model, stylized case studies, and a simulation case study.

Presented by

Nikolai Nowaczyk, Technical Specialist, NatWest

When and where?

Thu 21 Nov, 14:40, Arcadia 1 & 2

Buy-side boardroom

Structural factor investing

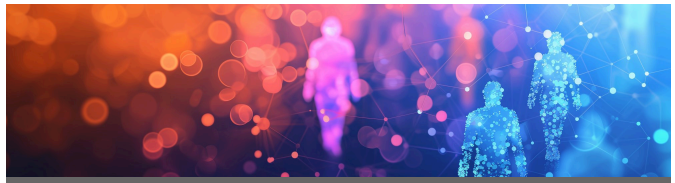
In this seminal paper, we introduce a unified theoretical framework for factor investing that stems from the structural relationship between equities and bonds.

Presented by

Hamza Bahaji, Head of Financial Engineering and Investment Solutions, Amundi ETF, Indexing & Smart Beta, Amundi

When and where?

Tue 19 Nov, 14:40, Cutty Sark 1 & 2



Rhetorical engineering for SWOT-based portfolio construction: identity, emotion, intention

We adapt classical rhetoric based on identity (ethos), emotion (pathos), and intention (logos) to communicate client identity and intentions.

Presented by

Hamza Bahaji, Head of Financial Engineering and Investment Solutions, Amundi ETF, Indexing & Smart Beta, Amundi

When and where?

Tue 19 Nov, 16:50, Cutty Sark 1 & 2

Minimum distance optimisation: A general-purpose alternative to mean-variance for institutional equity strategies

We present a new, general-purpose approach to portfolio optimization that can be used to control turnover in equity strategies, without introducing the path dependence normally associated with L1 trading constraints or penalty terms in the objective.

Presented by

Barney Rowe, Senior Quantitative Analyst, Fidelity International

When and where?

Wed 20 Nov, 14:00, Cutty Sark 1 & 2

Computation, data and innovation

Towards the lower bound for Bermudans

- It is important for designing "Bermudan discount" adjustment models prevalent in the industry for the last 30+ years
- We prove that generalized call spread is THE (achievable) lower bound

Presented by

Vladimir Piterbarg, Managing Director, Head of Quantitative Analytics & Development, NatWest Markets

When and where?

Tue 19 Nov, 17:20, Arora 13 & 16

Artificial Intelligence versus Augmented Intelligence

How to integrate Artificial Intelligence with the Human Experience in a complete investment process journey. Experience and past performance and future developments in a rapidly changing investment industry.

Presented by

Daniele Bernardi, CEO, Diaman Partners

When and where?

Wed 20 Nov, 14:00, Arora 13 & 16

Generative AI model risk management and the future of quants in banking

This session will present the unique challenges and best practices for establishing robust model risk management frameworks for LLMs.

Presented by

Fabien Choujaa, Head of Strats and Model Risk Management, HSBC

When and where?

Wed 20 Nov, 17:10, Arora 13 & 16

Quant tech and trading

Lenses for algorithmic trading

We show concrete examples of lenses and how to used them to improve algorithmic trading performance with the objective of being more competitive in these wheels.

Presented by

Gabriel Tucci, Global Head of Equities Cash Quant Trading, Citi

When and where?

Thu 21 Nov, 14:00, Arora 13 & 16

Machine learning-based detection of mean reversion in forex markets

In this talk, I will discuss the Local Extrema Predictor (LEAP), a machine learning algorithm designed to detect mean reversion in FX markets.

Presented by

Mike Emambakhsh, Senior Research Scientist, Mesirow

When and where?

Thu 21 Nov, 14:40, Arora 13 & 16

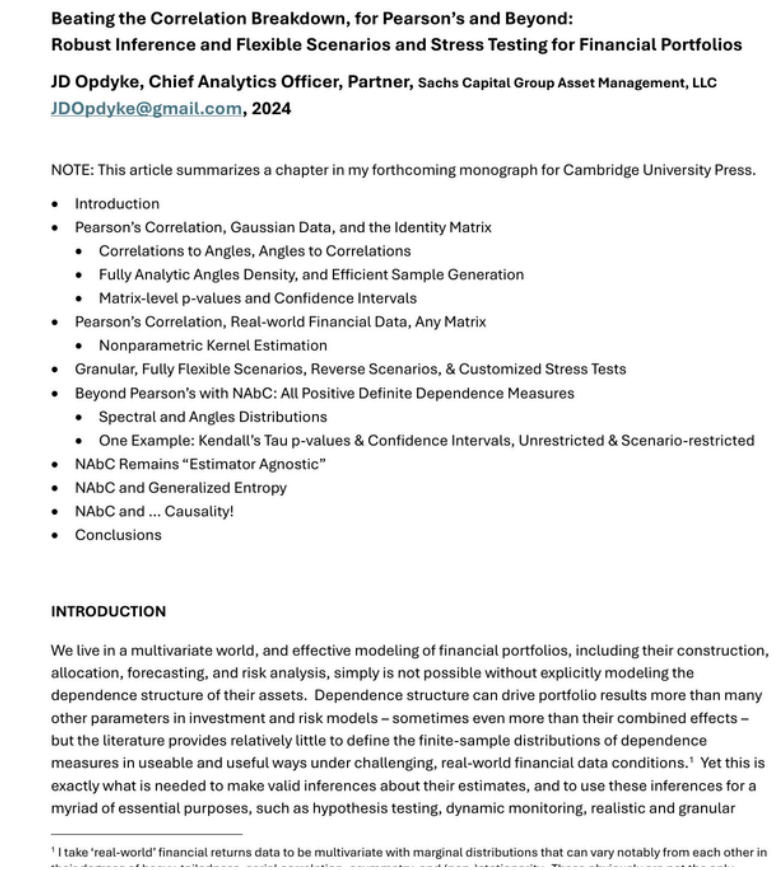
QuantMinds

BONUS CHAPTER

JD Opdyke, Chief Analytics Officer & Partner at Sachs Capital Group Asset Management, LLC, shares a chapter of his forthcoming book

Beating the Correlation Breakdown, for Pearson's and Beyond:
Robust Inference and Flexible Scenarios and Stress Testing for Financial Portfolios

Access the chapter below or read the summary here:



Beating the Correlation Breakdown, for Pearson's and Beyond:
Robust Inference and Flexible Scenarios and Stress Testing for Financial Portfolios

JD Opdyke, Chief Analytics Officer, Partner, Sachs Capital Group Asset Management, LLC
JDOpdyke@gmail.com, 2024

NOTE: This article summarizes a chapter in my forthcoming monograph for Cambridge University Press.

INTRODUCTION

We live in a multivariate world, and effective modeling of financial portfolios, including their construction, allocation, forecasting, and risk analysis, simply is not possible without explicitly modeling the dependence structure of their assets. Dependence structure can drive portfolio results more than many other parameters in investment and risk models – sometimes even more than their combined effects – but the literature provides relatively little to define the finite-sample distributions of dependence measures in useable and useful ways under challenging, real-world financial data conditions.[1] Yet this is exactly what is needed to make valid inferences about their estimates, and to use these inferences for a myriad of essential purposes, such as hypothesis testing, dynamic monitoring, realistic and granular

[1] I take 'real-world' financial returns data to be multivariate with marginal distributions that can vary notably from each other in

Introduction

We live in a multivariate world, and effective modeling of financial portfolios, including their construction, allocation, forecasting, and risk analysis, simply is not possible without explicitly modeling the dependence structure of their assets. Dependence structure can drive portfolio results more than many other parameters in investment and risk models – sometimes even more than their combined effects – but the literature provides relatively little to define the finite-sample distributions of dependence measures in useable and useful ways under challenging, real-world financial data conditions. Yet this is exactly what is needed to make valid inferences about their estimates, and to use these inferences for a myriad of essential purposes, such as hypothesis testing, dynamic monitoring, realistic and granular scenario and reverse scenario analyses, and mitigating the effects of correlation breakdowns during market upheavals (which is when we need valid inferences the most).

This is a summary of a chapter of my forthcoming monograph (of the same title) that introduces a new and straightforward method – Nonparametric Angles-based Correlation ("NAbC") – for defining the finite-sample distributions of a very wide

range of dependence measures for financial portfolio analysis. These include ANY whose matrix of pairwise associations is positive definite, such as the foundational Pearson's product moment correlation matrix, rank-based measures like Kendall's Tau and Spearman's Rho, as well as measures designed to capture highly non-linear and/or cyclical dependence such as the tail dependence matrix, Chatterjee's correlation, Lancaster's correlation, and Szekely's distance correlation, along with their many variants.

Motivation for NAbC's development has been its effective application to real-world financial portfolios (as opposed to textbook settings), so the solution is characterized by seven critically necessary results that no other method provides simultaneously:

1. NAbC remains valid under challenging, real-world data conditions, with marginal asset distributions characterized by notably different and varying degrees of serial correlation, (non-)stationarity, heavy-tailedness, and asymmetry[1]

2. NAbC can be applied to ANY positive definite dependence measure, including those listed above

3. NAbC remains "estimator agnostic," that is, valid regardless of the sample-based estimator used to estimate any of the above-mentioned dependence measures

4. NAbC provides valid confidence intervals and p-values at both the matrix level and the pairwise cell level, with analytic consistency between these two levels (i.e. the confidence intervals for all the cells define that of the entire matrix, and the same is true for the p-values; this effectively facilitates attribution analyses)

5. NAbC provides a one-to-one quantile function, translating a matrix of all the cells' cdf values to a (unique) correlation/dependence measure matrix, and back again, enabling precision in reverse scenarios and stress testing

6. all the above results remain valid even when selected cells in the matrix are 'frozen' for a given scenario or stress test – that is, unaffected by the scenario – thus enabling flexible, granular and realistic scenarios

7. NAbC remains valid not just asymptotically, i.e. for sample sizes presumed to be infinitely large, but rather, for the specific sample sizes we have in reality,[2] enabling reliable application in actual, real-world, non-textbook settings

[1] These obviously are not the only defining characteristics of such data, but from a distributional and inferential perspective, they remain some of the most challenging, especially when occurring concurrently as they do in non-textbook settings.

[2] This is conditional upon n>p, that is, the matrix is full rank, with more observations than assets. It cannot be positive definite otherwise.

Method summary

The key to NAbC's utility and broad range of application is its use of the angles between the pairwise vectors of returns, rather than the values of the pairwise correlations/ dependence measures themselves.[3] One angle corresponds to one correlation/ dependence measure value, and the entire matrix of angles uniquely identifies the matrix of correlation/ dependence measure values, and vice versa. There are four important reasons for the use of angles here:

A. **Automatic Positive Definiteness**: First, proper use of these angles places us on the **unit hyper(-hemi)sphere, where only positive definite samples exist**. This not only ensures that the sample space is valid, but also makes sampling from it efficient and fast.

B. **Distributional Independence**: Secondly, and crucially, **the distribution of each of these angles is *independent* with respect to those of the others**. This is critically important for practical usage as it enables the straightforward construction of the multivariate distribution of a matrix of angles, and thus, that of the correlation/ dependence measure, which is the more important objective here (vs merely sampling).

C. **Full Information**: Thirdly, **the angles between pairwise data vectors contain ALL the information that exists regarding dependence between the two variables**. The only information we lose in our jump to the hyper(-hemi)sphere is scale, and by design, scale remains irrelevant for dependence measures.

D. **General Conditions**: Finally, **the relationship between angles and the values of correlations/ dependence measures holds under the most general conditions: the pairwise matrix simply needs to be symmetric positive definite**. This weak condition remains true for essentially all dependence measures used in quantitative finance, and beyond, so NAbC has an extremely broad range of application.

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[3] The bivariate case of this is simply the widely known and used "cosine similarity." The multivariate case, i.e. the matrix analogue to the bivariate case, is well established and widely used in the literature (see Pinheiro and Bates, 1996, Rebonato and Jackel, 2000, Rapisarda et al., 2007, Pouramadi and Wang, 2015, and Cordoba et al., 2018).

The NAbC solution is sometimes even available in fully analytic form, such as for the narrow but foundational case of the Gaussian identity matrix (see below, and the link for the spreadsheet containing this solution: http://www.datamineit.com/DMI_publications.htm).

$$f_X(x) = c_k \cdot \sin^k(x),\ x \in (0,\pi),\ k = 1,2,3\ldots \#\text{columns} - 1, \text{ and } c_k = \frac{\Gamma(k/2+1)}{\sqrt{\pi}\,\Gamma(k/2+1/2)}$$

$$F_X(x;k) \sim \frac{1}{2} - \left(\frac{1}{2}\right) \cdot F_{Beta}\left[\cos^2(x); \frac{1}{2}, \frac{1+k}{2}\right] \text{ for } x < \frac{\pi}{2},$$

$$\sim \frac{1}{2} + \left(\frac{1}{2}\right) \cdot F_{Beta}\left[\cos^2(x); \frac{1}{2}, \frac{1+k}{2}\right] \text{ for } x \geq \frac{\pi}{2}$$

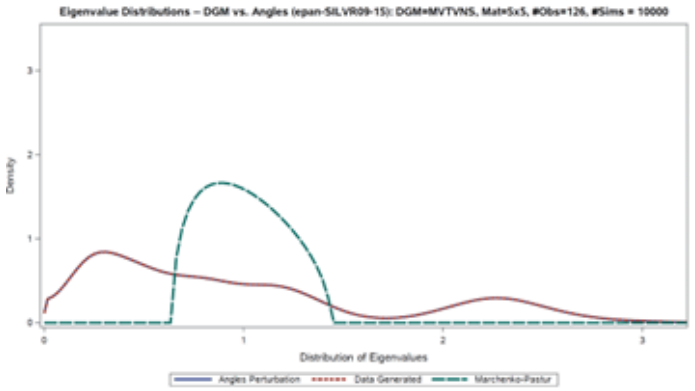
$$F^{-1}(p;k) = \arccos\left(\sqrt{F^{-1}_{Beta}\left(1-2p; \frac{1}{2}, \frac{1+k}{2}\right)}\right) \text{ for } p < 0.5;$$

$$= \pi - \arccos\left(\sqrt{F^{-1}_{Beta}\left(1-2[1-p]; \frac{1}{2}, \frac{1+k}{2}\right)}\right) \text{ for } p \geq 0.5$$

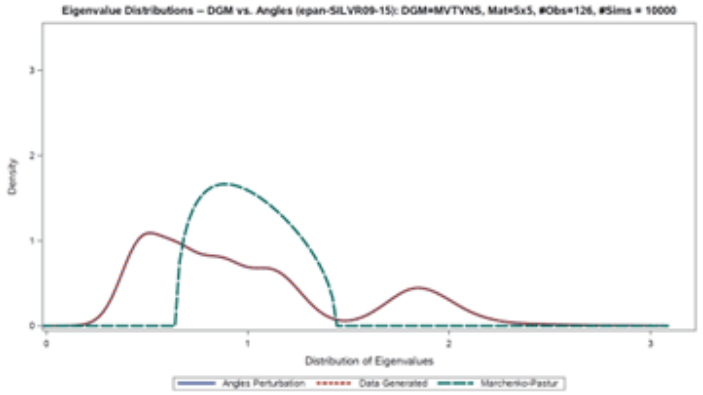
But NAbC extends way beyond this specific case to check all seven of the 'objectives' boxes above simply by estimating the distributions of the angles nonparametrically, via kernels. The implementation details are well established in the literature, straightforward, and shown in the attached article, which also presents a complete example of NAbC's implementation on Kendall's Tau under challenging data conditions, step-by-step. This example includes both the unrestricted and scenario-restricted cases, as described in the next section (I also include spectral distributions of just a few of the dependence measures covered in the full chapter article attached).

Graph 1: Spectral Distribution-NAbC Angles Kernel v Data Simulations v Marchenko Pastur

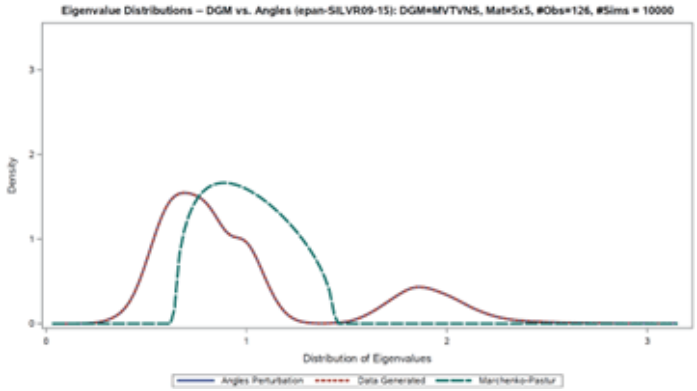
Pearson's Rho



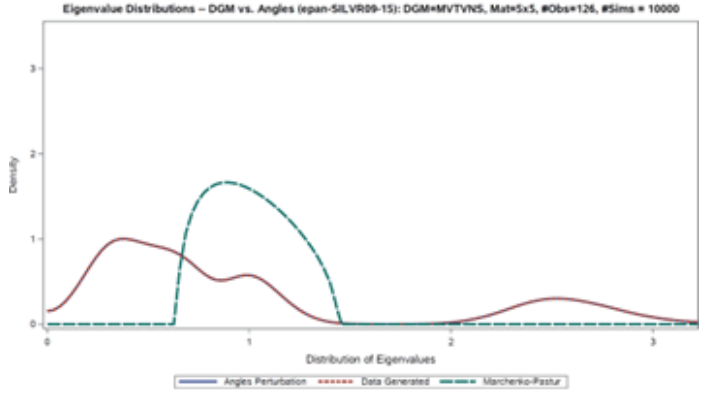
Kendall's Tau



Chatterjee's



Spearman's Rho+Chatterjee



Flexible scenarios, reverse scenarios, and realistic stress testing

Within the framework of the matrix of all pairwise associations,[4] NAbC exploits several results to provide full flexibility for scenario analytics. First, as mentioned above, i. independence of the angles distributions allows us to vary individual cells; second, ii. as established in the literature, the distributions of individual correlation cells, as well as the distribution of the entire correlation matrix, both remain invariant to the ordering of the rows and columns of the matrix (see Pourahmadi and Wang, 2015, and Lewandowski et al., 2009). Third, iii. based on i. and ii., we can exploit the simple mechanics of matrix multiplication so that only selected cells of the matrix are affected, and the rest frozen, as required for a given scenario: all that is required for this is a simple reordering of the rows and columns of the matrix.

Taken together, these three results, and NAbC's use of the "all-pairwise" framework, allow us to specify that ANY subset of cells within the structure of the all-pairwise matrix remain 'frozen,' i.e. unaffected by the scenario, thus eliminating the effects of so-called 'peripheral' correlations/associations. No other method provides anything close to this level of (valid) scenario targeting and flexibility. What's more, NAbC provides ancillary but potentially game-changing benefits beyond its immediate design purposes, including a new "Generalized Entropy," as well as effective use within the paradigms of Causal Modeling.

[4] Note that some of the abovementioned dependence measures can be implemented on a multivariate basis, and sometimes even in arbitrary and differing dimensions (e.g. Szekely's distance correlation, and variants of Chatterjee's correlation). However, multivariate dependence (as distinct from "all-pairwise" bivariate dependence) imposes limitations that NAbC avoids, as discussed in more detail in the attached chapter.

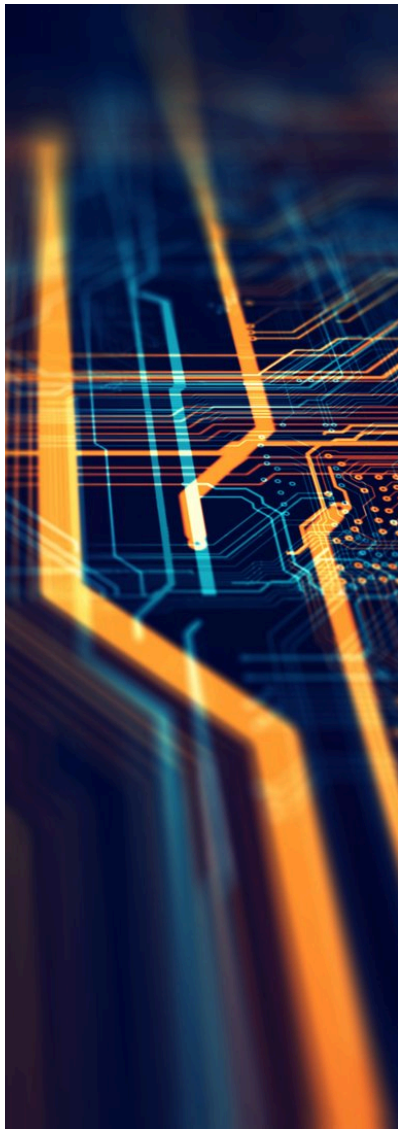
Generalized entropy

NAbC provides p-values, consistent across both the cell level and matrix level, that demonstrate a remarkable correspondence with the state-of-the-art entropy of the correlation/dependence matrix as derived and calculated in Felippe et al. (2021 and 2023). Yet the latter remains restricted to the case of perfect (in)dependence, whereas NAbC can provide the same entropy calculation using ANY values of the correlation/dependence measure as its baseline. Furthermore, NAbC's 'generalized entropy' is more granular and robust, as it is based on p(p-1)/2 cells, as opposed to only p eigenvalues. Finally, as a measure of 'distance,' NAbC's generalized entropy has multiple advantages over commonly used norms (e.g. the taxi, Chebychev's, and Euclidean/Frobenius norms (collectively, the Minkowski norm)) as it rests on a solid probabilistic foundation, while norms do not and consequently, often lack interpretation in this setting. Entropy has been used increasingly in the literature to measure, monitor, and analyze financial markets (see Meucci, 2010b, Almog and Shmueli, 2019, Chakraborti et al., 2020, and Vorobets, 2024a, 2024b, for several examples), so this 'generalized entropy' is not only highly relevant, but also very intriguing with possibly far-reaching consequences in this setting.

Causal Modeling

Finally, even as an association-based method that broadens, enables, and enhances robust statistical inference in challenging, real-world financial settings, NAbC can be used to tackle questions posed within causal modeling paradigms. Its broad range of application allows for its use on asymmetric, DIRECTIONAL dependence measures, including Chatterjee's new correlation coefficient (Chatterjee, 2021), the improved Chatterjee's coefficient (Xia et al., 2024), Zhang's (2023) combined correlation measure, the QAD measure of Junker et al. (2021), the asymmetric tail dependence measure (Deidda et al, 2023), and others. Because these all are DIRECTIONAL, we can map their inferential results – that is, their individual, cell-level p-values – to the different variable effect classifications of models based on directed acyclical graphs (DAGs)): the mediators, confounders, and colliders, as well as the vanilla causal and 'caused by' covariates (see MacKinnon & Lamp, 2021). All it takes is two runs of NAbC, one in each 'direction.' The subsequent mapping of results is exhaustive and mutually exclusive, so we can proceed with a rigorous,

inferential analysis that identifies, probabilistically, the 'causal' relationships between the variables. This obviously does not address the bigger question, however, of whether DAGs can be used reliably within "self-referencing open systems like capital markets" (Polakow et al., 2023); only that it appears NAbC can play a role in recovering them if the answer to this question is "yes" or "under some conditions."



Conclusion

To date, financial portfolio analytics in practice very often relies on ad hoc, largely qualitative, and 'judgmental' approaches to specifying and utilizing dependence structure, and when quantitative approaches are used, their valid application largely has been restricted to narrow cases. With NAbC, however, we now have a powerful, applied approach enabling us to treat an extremely broad class of ubiquitous dependence measures with the same level of analytical rigor as the other major parameters in our (finite sample) financial portfolio models. NAbC's utility holds under the most challenging, real-world financial data conditions, and for extremely flexible and targeted scenarios. We can use NAbC in frameworks that identify, probabilistically measure and monitor, and even anticipate critically important events, such as correlation breakdowns, and mitigate and manage their effects. It can even be used within causal paradigms! It should prove to be a very useful means by which we can better understand, predict, and manage portfolios in our multivariate world.

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