QuantVision 2025: PANEL – Understanding the Future of Machine Learning in Quantitative Finance

The Best Methods Applying Causal Frameworks to Quantitative Finance will (continue to) be Reliant on Association-based Methods, JD Opdyke, Chief Analytics Officer, DataMineit, LLC

"Association is a-directional, however, causality is directional …" August 2, 2024, first sentence of a professor's video introduction to a causal modeling contest (**https://www.youtube.com/watch?v=AVBE5HLDUIw**).
"Third, unlike association, causality is directional …" causal investing monograph, 2023, p.5

Contrary to this claim, the literature provides many directional measures of association, some published over a dozen years ago,* in very highly regarded journals (e.g. Journal of the American Statistical Association, Journal of Nonparametric Statistics). I list below references to just a few of these, some of which have been used directly in causal modeling frameworks, although the methods themselves remain, unarguably, association-based:

- **Generalized Correlation**: Zheng, S., Shi, N.-Z., and Zhang, Z. (2012), "Generalized Measures of Correlation for Asymmetry, Nonlinearity, and Beyond," *Journal of the American Statistical Association*, 107, 1239–1252.
- **Chatterjee's New Correlation Coefficient**: Chatterjee, S., (2021), "A New Coefficient of Correlation," *Journal of the American Statistical Association*, Vol 116(536), 2009-2022. (available on arXiv 2019)
- **Improved Chatterjee's Correlation**: Xia, L., Cao, R., Du, J., and Chen, X., (2024), "The Improved Correlation Coefficient of Chatterjee," *Journal of Nonparametric Statistics*, 1-17.
- **Szekely's+Chatterjee's - multivariate distance-based Chatterjee's**: Pascual-Marqui, R., Kochi, K., and Kinoshita, T., (2024), "Distance-based Chatterjee correlation: a new generalized robust measure of directed association for multivariate real and complex-valued data," arXiv:2406.16458 [stat.ME].
- **Spearman's+Chatterjee's**: Zhang, Q., (2023), "On relationships between Chatterjee's and Spearman's correlation coefficients," *Communications in Statistics-Theory & Methods*, 54(1), 259-279 (on arXiv 2023)
- **Asymmetric Tail Dependence**: Deidda, C., Engelke, S., and De Michele, C., (2023), "Asymmetric Dependence in Hydrological Extremes," *Water Resources Research*, Vol. 59, Issue 12.
- **Directional Tail-weighted**: Li, X., and Joe, H., (2024), "Multivariate Directional Tail-weighted Dependence Measures," *Journal of Multivariate Analysis*, Vol 203.
- **Dynamic Asymmetric Tail**: Ito, K., & Yoshiba, T., (2025), "Dynamic Asymmetric Tail Dependence Structure Among Multi-Asset Classes for Portfolio Management: Dynamic Skew-t Copula Approach," *Intl Rev of Economics & Finance*, V97.

Impressive original insights notwithstanding, some of the best causal models are in no small part built directly on measures of association (see for example Rodriguez Dominguez, 2025; Nanmo and Kuroki, 2025; and Pascual-Marqui et. al., 2024). Drawing a false, bright line separating association-based methods from causal frameworks is at best, a misleading strawman, and at worst, a serious limitation on research progress for the latter. Making strides toward the effective application of causal frameworks *to quantitative finance*,** where possible, will be incremental and based in nontrivial ways on many decades of rigorous association-based research and methods, even in the face of paradigm shifts; claims to the contrary should be met with with strong scientific skepticism.

Notes:
* This actually was first addressed over 125 years ago by Yule (see Yule, G.U., (1897), "On the Significance of Bravais Formulæ for Regression, in the case of skew correlation," *Proceedings of The Royal Society London*, 477-489. Also see Allena, D., and McAleerb, M., (2018), "'Generalized Measures of Correlation for Asymmetry, Nonlinearity, and Beyond': Comment," ICAE – Instituto Complutense de Análisis Económico, Working Paper 1823.)

** Application of causal frameworks to controlled settings such as clinical trials, for example, differs dramatically from their application to "self-referencing open systems like capital markets" (Polakow et al., 2023).

Additional References:

- Nanmo, H., and Kuroki, M., (2025), "PCM Selector: Penalized Covariate-Mediator Selection Operator for Evaluating Linear Causal Effects," *The Thirty-Ninth AAAI Conference on Artificial Intelligence (AAAI-25)*.
- Rodriguez Dominguez, A., (2025), "Causal Portfolio Optimization: Principles and Sensitivity-Based Solutions," arXiv:2504.05743v2 [q-fin.PM].
- Polakow, D., Gebbie, T., and Flint, E., (2023), "Epistemic Limits of Empirical Finance: Causal Reductionism and Self-Reference," arXiv:2311.16570v2 [q-fin.GN].