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Why Dario Villani trusts machine learning

Duality Group CEO says people should abandon ‘top-down, godlike model’ and their need to understand



Man versus machine: Villani says machine learning is more flexible than traditional modelling approaches

Faye Kilburn

[@Fayekilburn](#)

05 Nov 2018

When Dario Villani was a child on the Amalfi coast in southern Italy, his father was convinced anti-lock braking systems would never improve on the rapid reflexes of human drivers. He did not trust the new brakes to do a better job of keeping cars from careening off the twisty roads edging the Mediterranean than a human driver could.

Perhaps this is why Villani has faith that Wall Street will one day embrace machine learning – despite its lack of any track record so far.

“Human portfolio managers have a hard time not falling victim to being either too obstinate or too quick to succumb to weak knees when losses happen,” he says of his flesh-and-blood colleagues.

Today, most of the world’s largest fund managers are dabbling in machine learning to automate execution, to extract patterns from data or to improve upon traditional investment signals. Very few, however, are using machine learning to forecast asset prices for alpha generation.

“There are very few household names I can point to but, anecdotally, it seems there are certainly a couple of groups out there who are on the right path as it relates to machine learning for forecasting,” he says.

“As for the big guys with a lot of resources, you’d think they would have launched a dedicated product given how hungry investors seem to be to find a home for the marginal dollar in low beta strategies that is not factor, traditional stat arb or some pseudo high-frequency which probably has limited capacity,” Villani scoffs.

Villani put his money where his mouth is when he left his post as global head of portfolio strategy and risk at the hedge fund manager Tudor Investment in August last year to set up his own machine learning-driven shop – the Duality Group. Its specialised neural network architecture is instructed with objective and risk parameters, but has no real human intervention in terms of vetting the actions the system takes based on what it has learned, Villani says.

From self-driving cars to supermarket checkouts, the man versus machine debate is percolating through all corners of society. In capital markets, asset managers are taking a conservative approach: that the output of any model must be tied back to an economic rationale or fundamental underpinning. Most firms still have a sentient being clearing the output of their machine learning models.

To him, it’s a moot question [to ask why](#) a machine makes the choices it does. And it goes to his scepticism of human ability to know with certainty the reason for any given outcome.

“There is a beautiful video of Feynman trying to explain [what ‘why’ really means](#) and how deep you can go,” he says, referring to theoretical physicist Richard Feynman.

“People who believe they understand why they made money just because they answer within a model of the world they postulated, are, in my opinion, much further away from explaining what’s going on than people using machine learning architecture,” he says.



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Dario Villani

Villani's background in theoretical physics – he holds a PhD from the University of Salerno – instilled in him the reductionist perspective that there are fixed physical laws governing our universe. But his experience managing multi-billion dollar portfolios within credit, interest rates and commodities led him to abandon the idea that humans can design a model of how financial markets work – a key premise of his outlook.

“Ironically, when a scientist enters the world of finance, folks with more traditional backgrounds usually get worried he or she will be obsessed with trying to find Newton's law of markets which, deep down, we all know doesn't exist,” he says.

“Abandoning a top-down, godlike model is really an acknowledgement that, in markets, we have tenuous relationships forever transitioning in a sea of noise,” he adds.

Arguably the biggest obstacle to building a model of the markets is that they have a dynamic or evolutionary element to them, and can change at the drop of a hat. But machine learning, Villani argues, is more flexible than traditional modelling approaches, as it allows transition not just between different parameters but also to qualitatively different models, almost like a chameleon.

Villani conjectures that machine learning will be revolutionary in risk management as well, since the entire practice rests on assessing how things are changing with respect to what was expected to happen *ex ante*.

“Machine learning fundamentally changes that pursuit, as we can constantly update our notion of what to expect in a meaningful way. You

will stop hearing statements like, ‘This was a 40 standard deviation event’,” he adds.

But for all his bravado, Villani acknowledges that machine learning has shortcomings that have held it back on Wall Street compared with, say, Silicon Valley. On top of a low signal to noise ratio and non-stationarity of financial markets, machine learning has been of no use whatsoever in forecasting tail-risk events, a common complaint.

“Rare events or outliers are a major potential stumbling block,” he says, but adds that it’s all about letting the machine learning know rare events happen without overweighting their importance.



You need an architecture that can learn that extreme moves can happen

Dario Villani

“Again, it’s about striking a balance. You need an architecture that can learn that extreme moves can happen without distorting the learning process to accommodate the delusion you could forecast something like a Tepco stock crashing after the blow-up of a nuclear reactor,” he adds, referring to the Tokyo Electric Power Company share price collapse after an earthquake and tsunami demolished much of its Fukushima Daiichi nuclear complex in 2011.

Villani founded Duality with Kharen Musaelian, Alexander Sokol and Jeffrey Ziglar. Musaelian, the chief investment officer, won medals as a teenager in the Mathematics and Physics Olympiads of the Soviet Union and Armenia, and learned his trade at Merrill Lynch, BlueCrest Capital Management and the proprietary positioning business of JP Morgan, where he managed multi-billion dollar investment portfolios. Chief technology officer Sokol was 14 when he was accepted into the Moscow Institute of Physics and Technology – at the time, the youngest student ever admitted. He went on to found fintechs Numerix and CompatibL. Meanwhile, Ziglar, the chief operating and financial officer, came up through the ranks at Carlyle Group, Jefferies, Goldman Sachs and UBS Investment Bank.

So. If Villani is not worrying about the machines malfunctioning, what does keep him up at night?

As more asset managers look to augment their business with artificial intelligence, there is a potential for crowding in the space, he says, with machines turning out similar findings and trading in the same way. But according to Villani this scenario is a long way off. Furthermore, he adds, funds using machine learning have the capacity to differentiate themselves, just as humans do.

“What distinguishes one machine-learning fund from the next is the architecture, the brain of each and the way they process data,” he says. “Humans have evolved to have nearly identical visual cortexes to each other, yet we look at things in very different ways.”

Dario Villani is CEO and co-founder of Duality Group and a visiting lecturer at Princeton University. He has managed multi-billion dollar portfolios within credit, interest rates and commodities. Previously, he served as global head of portfolio strategy and risk at Tudor Investment Corporation. He shared the 2016 Risk Buy-Side Quant of the Year Award, and has authored research papers in finance, theoretical physics, statistics and portfolio management. He holds a doctorate in theoretical physics from the University of Salerno and a masters in finance from Princeton University.

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