Mean Reversion systems during COVID-19 (Black Swan event)

Use of disruptive technologies to enhance traditional models.

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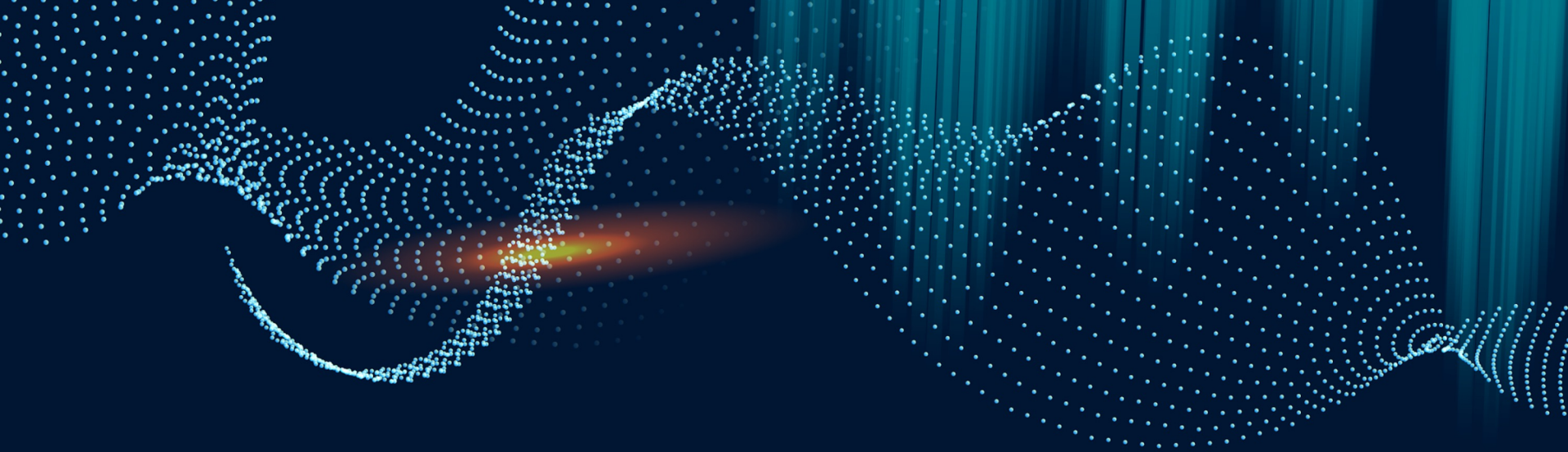


01 Algorithm

Mean Reversion strategy with
Bollinger Bands vs. Buy & Hold

Allocator Algorithm : pipeline

Input

IBEX35

From the endpoint, we obtain all the historical data by ticker and date range.

Execution

100.000 €

python™

We execute the algorithm daily, sending the resulting orders to the broker.

We will send the orders before the opening (between 7 and 9 in the morning).

Output

	A3TV	ABE	ABG	ABG.P_0	ABG.P_1	ACS	ACX	ACX_0	AENA	AGS
2003-01-02	0.0	0.034483	0.0	0.0	0.0	0.034483	0.0	0.034483	0.0	0.0
2003-03-14	0.0	0.033333	0.0	0.0	0.0	0.033333	0.0	0.033333	0.0	0.0
2003-05-28	0.0	0.033333	0.0	0.0	0.0	0.033333	0.0	0.033333	0.0	0.0
2003-08-06	0.0	0.033333	0.0	0.0	0.0	0.033333	0.0	0.033333	0.0	0.0
2003-10-16	0.0	0.033333	0.0	0.0	0.0	0.033333	0.0	0.033333	0.0	0.0

The output is similar to an index, or an ETF.

On a daily basis, we indicate the percentage of capital in which we want to be invested for each asset in the index

All sales operations will be carried out at the opening auction

All purchase operations will be carried out at the closing auction

We will send the orders before the opening (between 7 and 9 in the morning).

First of all, a few key concepts...

- **Sharpe Ratio**: it measures the return of an investment relative to its volatility, adjusting for the underlying cost of capital. In other words, it indicates how well an equity investment performs in comparison to the rate of return on a risk-free investment (e.g. U.S. treasury bonds or bills)

- **Jensen's Alpha**: is a risk-adjusted performance measure that represents the average return on a portfolio or investment, above or below that predicted by the capital asset pricing model (CAPM), given the portfolio's or investment's beta and the average market return. In other words, it is the difference in how much a person returns vs. the overall market (benchmark).

So, what is considered a good Sharpe ratio or Jensen’s alpha?

- A good Sharpe ratio indicates a high degree of expected return for a relatively low amount of risk.

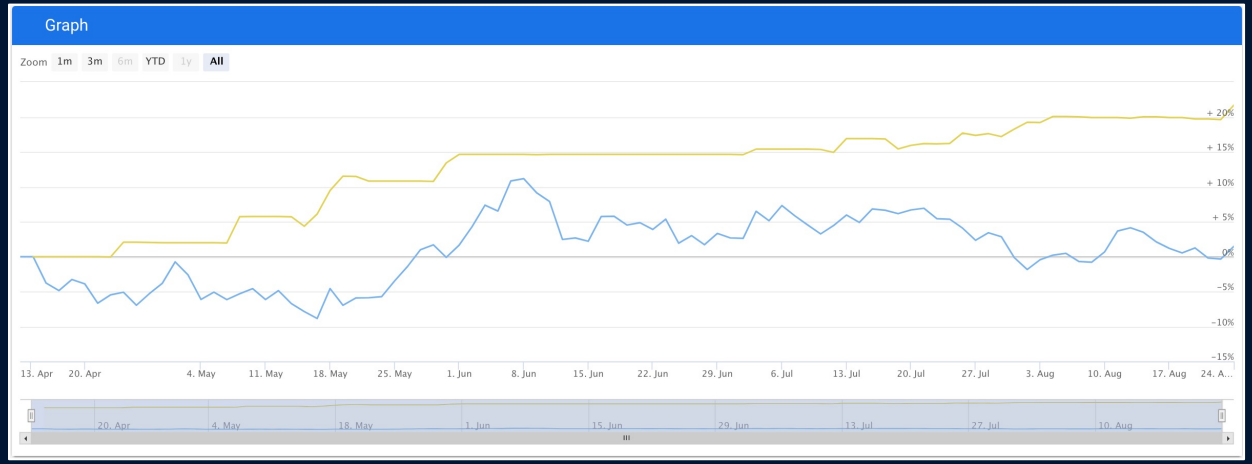
Usually, any Sharpe ratio greater than 1.0 is considered **acceptable to good by investors**. A ratio higher than 2.0 is rated as **very good** & a ratio of 3.0 or higher is considered **excellent**.

- Jensen's measure is one of the ways to determine if a portfolio is earning the proper return for its level of risk.

If the value is positive, then the portfolio is earning excess returns. In other words, a **positive value** for Jensen's alpha means a fund manager has "beat the market" with their stock-picking skills.

Mean Reversion with BB

Algorithm IBEX 35 TR

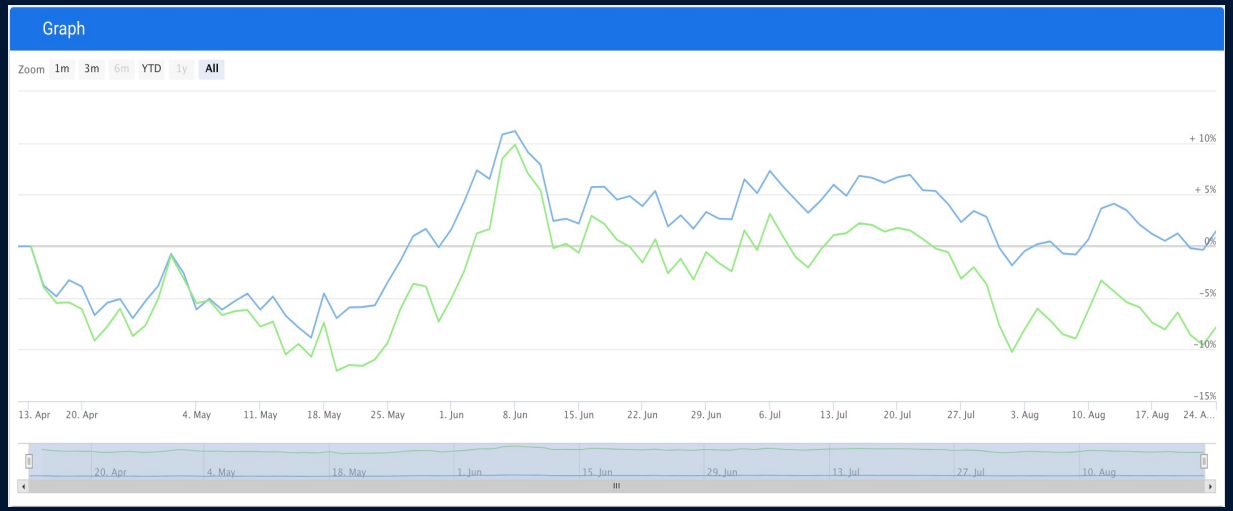


Hedge Fund numbers!!! Great... But why?

ANNUALIZED RETURN : 72 % SHARPE RATIO : 4.57 JENSEN'S ALPHA : 72%

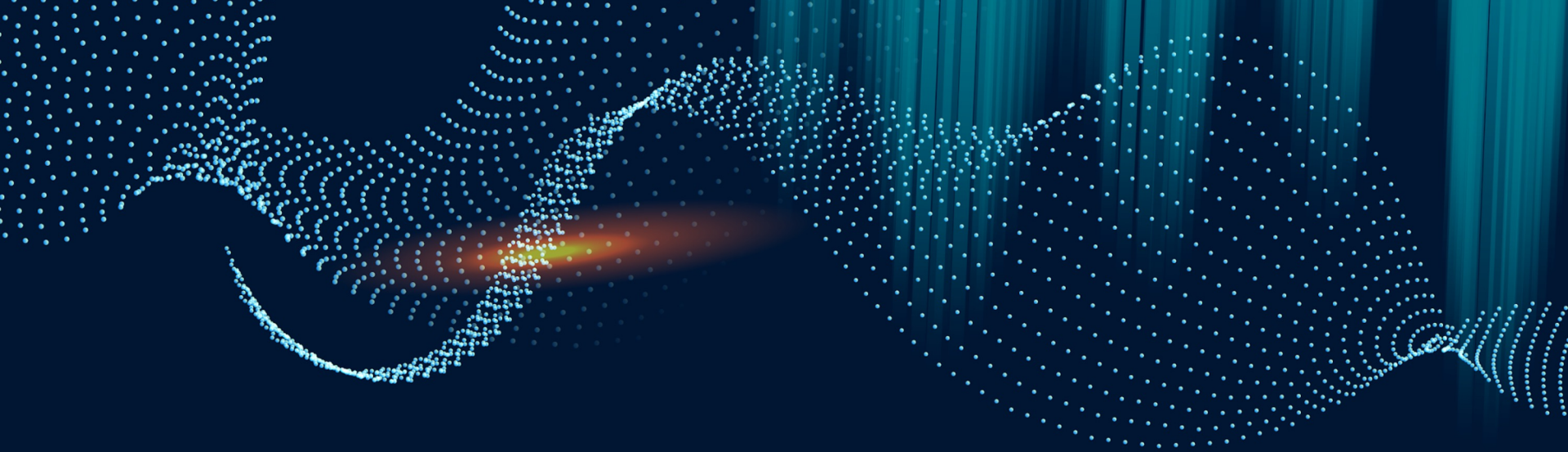
Buy & Hold

Algorithm IBEX 35 TR



Why those bad numbers in such a profitable strategy?

ANNUALIZED RETURN : -20.2 % SHARPE RATIO : -0.62 JENSEN'S ALPHA : -20.2%



02 Context

COVID-19 event : Black swan

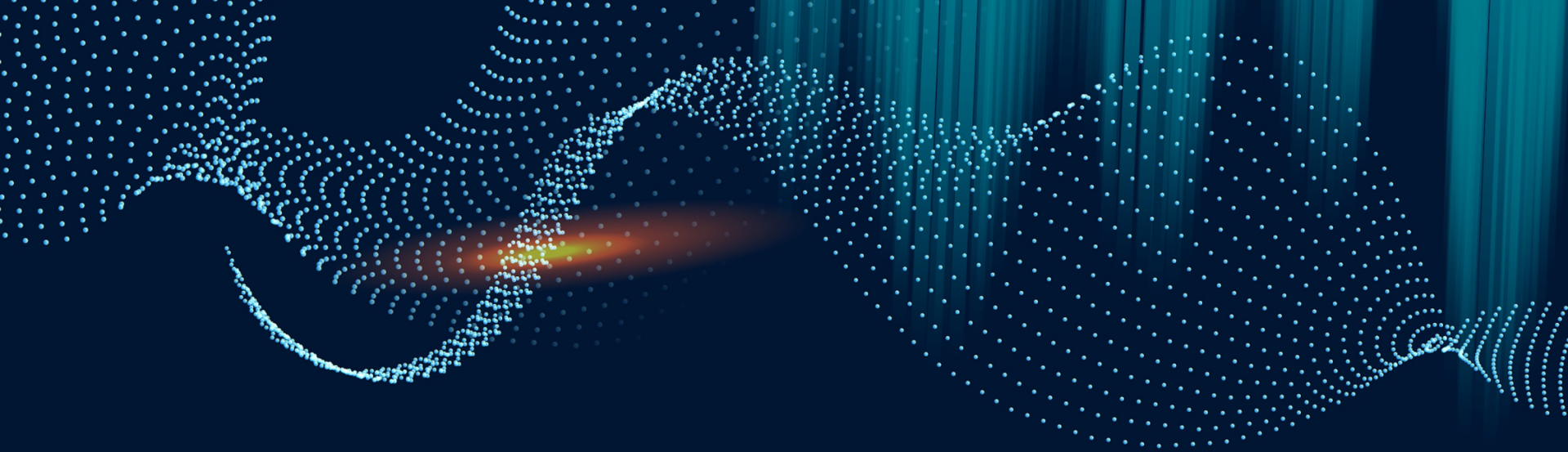
Why those results ? Black Swan phenomenon

This algorithm was executed during COVID-19 crisis which is a Black swan event, like 11-S or Brexit.

IBEX 35 has met all key features of Black Swan events which are the following:

- Be an unexpected event, difficult to predict and that constitutes a surprise.
- Have a big impact on the economy and politics.
- In hindsight, be predictable

Mean reverting strategies are effective during Black Swan events, e.g. IBEX 35 performance during COVID-19 crisis.



03 Results

How to improve those results?
Quantum computing applied
to finance

Quantum computing applied to finance - Overview

- Material science
- **Finance**
- Chemistry
- Optimization
- Machine learning
- ... and whatever you can imagine, and much more

WHO?

- Banks
- Central banks
- Finance departments
- Rating agencies
- Regulators
- Tax offices
- ...

Quantum computing applied to finance – Quantum optimization (I)

Question	Broad approach
Which assets should be included in an optimum portfolio, and how should one change its composition according to the market?	Optimization models **Quantum optimization**
How to detect opportunities in the different assets in the market, and take profit by trading them?	Machine learning **Quantum machine learning**
How to estimate the risk of a portfolio, a company, or even the whole financial system?	Monte Carlo **Quantum amplitude estimation**

Quantum computing applied to finance - Quantum optimization (II)

We need a tool to solve optimization problems (i.e., finding the best solution, or at least a good one, from many posible options) => in physics: energy minimization problem

$$f(x_1, x_2, x_3) = (x_1 + x_2 + x_3 - 1)^2$$

$$= 2x_1x_2 + 2x_2x_3 + 2x_1x_3 - x_1 - x_2 - x_3 + 1$$

QUBO formula (QUadratic Binary Optimization)

Quantum + AI

3 ways quantum computers could change the future of AI:

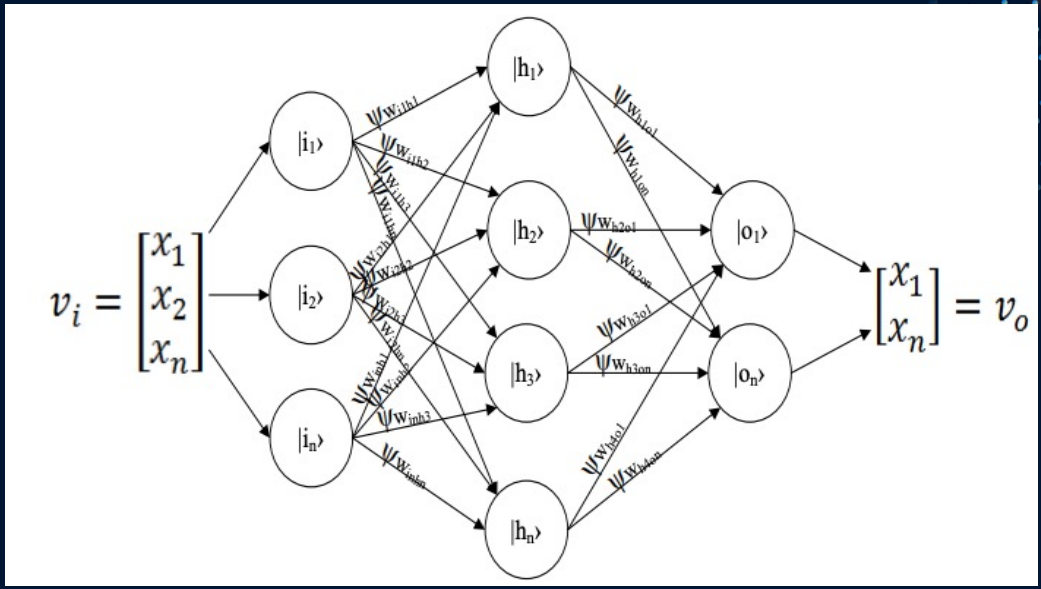
- **Building Better Models:** An industry like finance, is nearly at the end of its classical computing rope. It requires complex models that classical computers just can't generate. Quantum computers, have the potential processing power to model the most complex situations.

- **More Accurate Algorithms:** more efficient reinforcement learning models. Training accelaration using quantum computers. Less time consumption and more computing workload.

- **Using Multiple Datasets:** quantum computers could handle the integration of different datasets for much quicker and easier analysis.

Quantum Artificial Neural Network (QANN) (I)

- The structure of a quantum feed forward artificial neural network does not differ from a normal one, but the concept of linear superposition is one of the differences that can be described graphically by the picture.



Quantum Artificial Neural Network (QANN) (II)

Is it posible to predict financial turnmoils with QANNs?

Overall Network Superposition: As the linear superposition indeed dictates that any possible configuration of each Qbit exists at once and as, related to the example QANN, any of these (weight) configurations has numerous configurations of thresholds, an impracticality occurs, namely the coexistence of identical configurations in one superposition.

Thus, one configuration of a quantum artificial neural network must include both the weights and the neuron thresholds.

CONCLUSIONS

1. Mean reverting strategies are very effective during Black swan events.
2. Use of ML, DL and Quantum will enhance traditional models solving complex models.
3. Optimization and allocation are two main aspects in which quantum would make a great difference.
4. QANNs might predict financial turnmoils derived from Black swan events.

Motivation

Using less time = earning more money

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Thank you for your time!