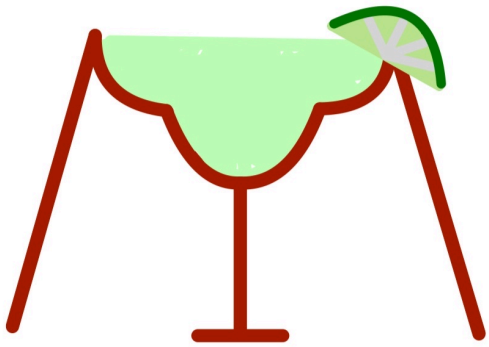

# Margaritaville Mutual Strategy Proposal

## - The META Fund -

## A Copula-based Trading Strategy

As part of the course: Financial Data Analytics in Python
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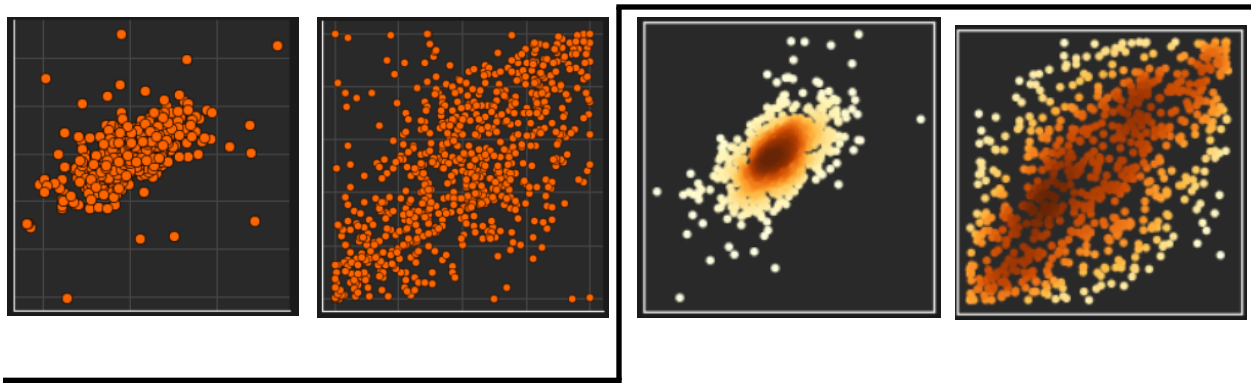
## Grounded in numbers

The strategy consists of analysing the state of META compared to the state of the Tech market. Modeling the relationship of movements in META compared to Apple, Amazon, Netflix, Google, Microsoft, and Nvidia. By avoiding the overall trends of the market, trades limit risk by only trading on the strongest signals, indicating META being over or under-valued. Through backtesting, META was the best and most consistent performer.

## Predictability in data

Hidden in the sea of data exists the true value of an asset. At Margaritaville Mutual, data is no mystery. With the power of a Copula Trading Model, any dependency between value fluctuations can be easily modeled, even scaled up to 7 dimensions to encompass the aforementioned stocks. Between any two stocks, their relationship can be observed from this higher dimension model, as can be seen below on the left. The first figure shows the log-return data, while the second removes marginal distributions of each stock return. This figure is similar to ordering the observations uniformly by their ranks, which is what copulas do in order to model the underlying dependency structure.



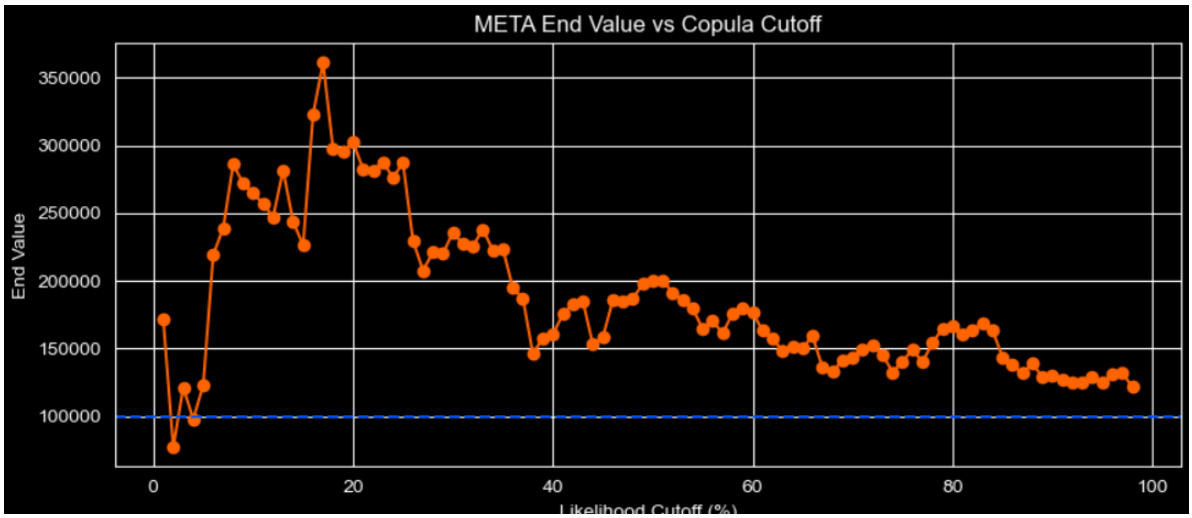
## A Slice of the Model

With the modeled relationships, quantified likelihood of any given state of the market can be found. On the right, heatmaps of how common movements between the stocks are shown, both in real and uniform space. A light point would indicate for example a major increase in the first stock, while the other had no movement. This may indicate an abnormality in the first stocks valuation, making for a valuable trading signal.

## Backtesting Results

When testing the strategy, it is clear that it is independent from the market's fluctuations. While not outperforming a buy and hold strategy, the copula based trading shows reduced risk. The performance is close to the baseline, while not being exposed to the full extent of risk in the market. The particular plot below shows performance when signals are generated from the 30th percent least likely fluctuation of META compared to the other tech stocks.


Furthermore, this cutoff for defining extreme events was varied. The end measure being the value at the end of the same time period. 30 percent has a good balance for performance, and stability in revenue. This cutoff was also chosen looking at similar plots for all stocks involved. The Sharpe Ratios of these backtests range from -0.25 to 1.5.



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## Performance Metrics

| Yearly Revenue | | |
|---|---|---|
| Start | Copula Strategy | Buy and Hold |
| 2021 | 53 % | 14 % |
| 2022 | 12 % | 31 % |
| 2023 | 23 % | - 65 % |
| 2024 | 2 % | 310 % |
| 2025 | 9 % | 58 % |

| Overview | |
|---|---|
| Sharpe Ratio | 1.35 |
| Max Drawdown | 20% |

| Assumptions | |
|---|---|
| Fees | 0.001 |
| Slippage | 0.0002 |

## Paper Trading

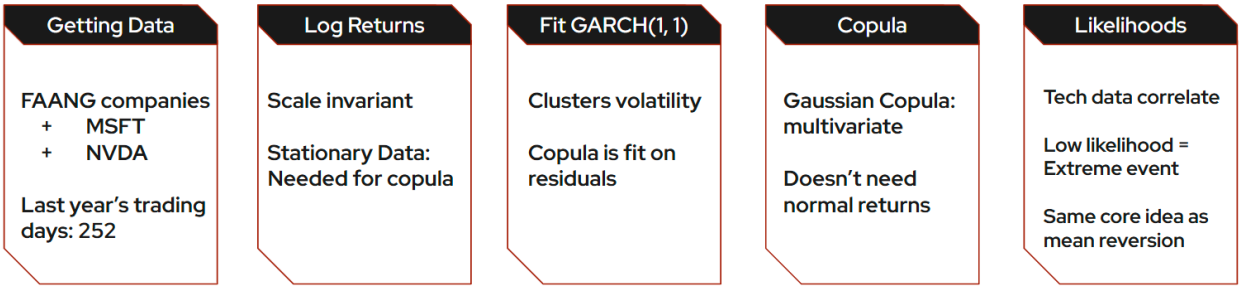
Paper performance metrics are not available due to the low volume of trades. Only with scaling up to trade many assets over many years would there be enough data for performance metrics. For the time being only back testing metrics are available. The strategy is a long term investment algorithm with minimal risk exposure.

## Technical Details and Economic Intuition

The strategy only works with a long time horizon. It assumes tech stocks move together, and any deviation from this would lead to a mean reversion. Even as external shocks impact stock price, assets in the same sector are assumed to be influenced similarly. The algorithm is run once a day, on closing prices. Any finer resolution of data introduces more randomness during the day, which can not be explained by the copula model and dependencies between stocks.

The strategy does not follow trends in the market, signals are purely generated from a stock price change being significantly different from the rest. Margaritaville Mutual's Copula-based Trading Strategy offers a long term, low risk, and mathematically backed way to diversify any portfolio.

## Data Pipeline




## Limitations and Risks

### Mean Reversion

Standard mean reversion uses one stock time series and tries to model a mean value s revert to. However, the strategy assumes the rest of the market's behaviour as a baseline for the overall valuation of tech stocks. One risk remains: An unexplained spike up or down in a stock's value can indicate a new market equilibrium. This has the risk of being unrelated to other tech stocks, leading the trade signal to not capture the intended variation in value fluctuation.

One may assume external shocks to the tech stock market would influence multiple stocks, and rarely only 1. More research would have to be done, possibly changing the lower bound of what defines an unusual price difference. With the latter perhaps signaling new market equilibrium, which should be excluded from being considered a trading signal.

### Market Crashes

In the case of a market crash of tech stocks, trades would only be executed if one stock stands out. This is the intended way of limiting risk, with the strategy not following the market, but by capitalizing solely unusual deviations. A downside of not capturing a market crash as a single is the chance of losing money with an open position.

### Copulas

Copulas require much data for estimation, especially for 7-dimensional dependency structures. There is a risk that these relationships between stocks change over time, leading to non ideal model predictions. However this is mitigated by the fact that the copula is fit for the last 252 observations before any given trade signal is processed.