# StratFusion: Synthesizing Trading Strategy in Stock

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# Strategy Motivation

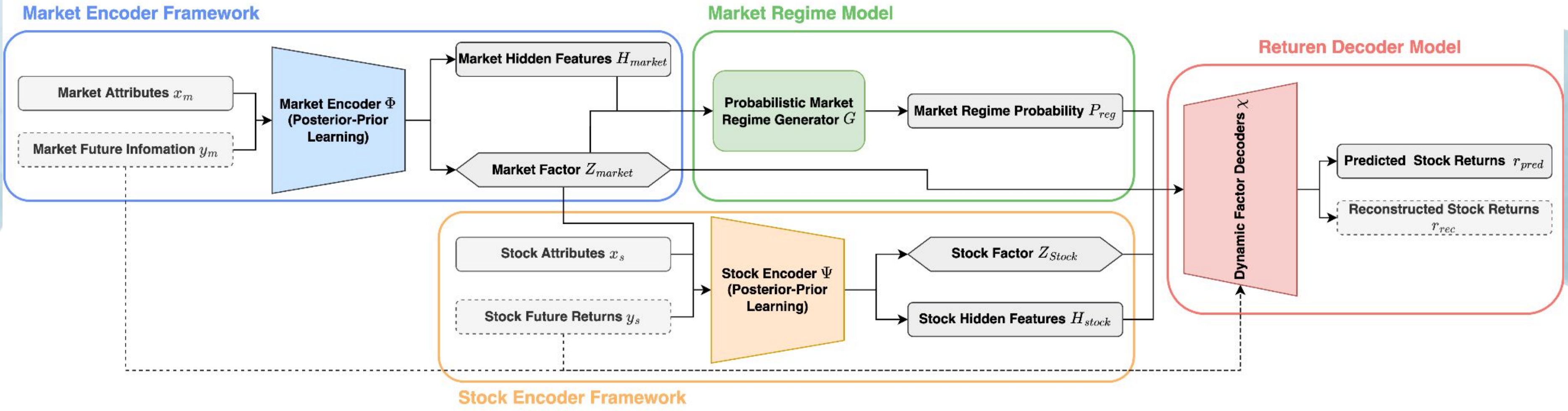
# Want more diversification for strategy

- Multifaceted nature of global financial markets
- Risk-Return Balance
- External Factor Tempering

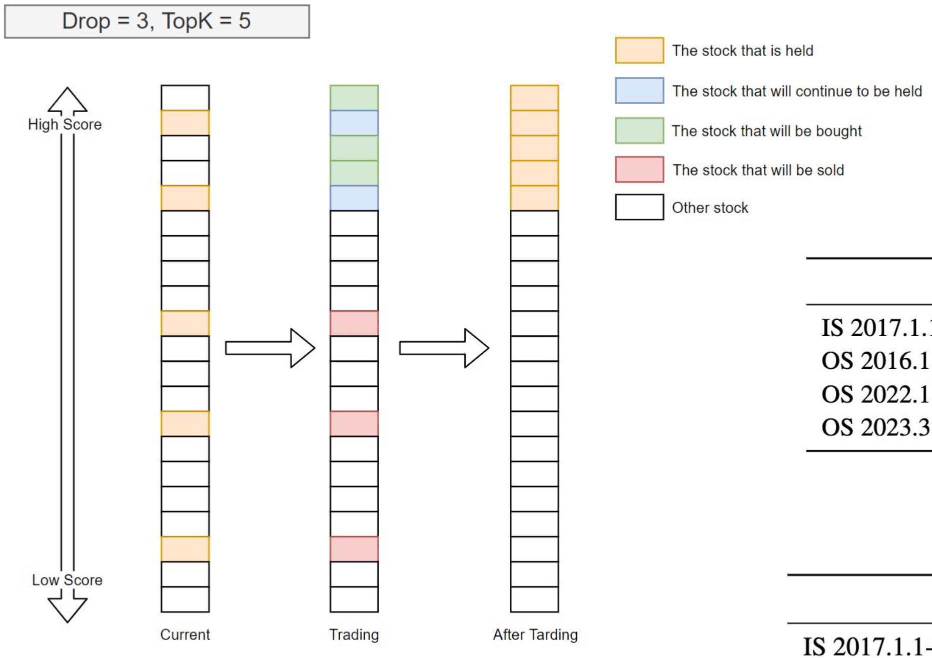
# Strategy 1: RegimeEvoVAE

# Background

- Fama & French Factor Model
- Market Regime: e.g Bull & Bear market
- Regime Switching Factor Model
- Variational Autoencoder



# TopK Dropout Strategy




| | Sharpe Ratio | Max Drawdown | Compounding Annual Return |
|---|---|---|---|
| IS 2017.1.1-2021.1.1 | 0.789 | 34.20% | 25.70% |
| OS 2016.1.1-2017.1.1 | 0.465 | 12.90% | 8.94% |
| OS 2022.1.1-2022.11.1 | -0.658 | 23.70% | -18.75% |
| OS 2023.3.10-2023.10.10 | -0.448 | 10.30% | -3.17% |

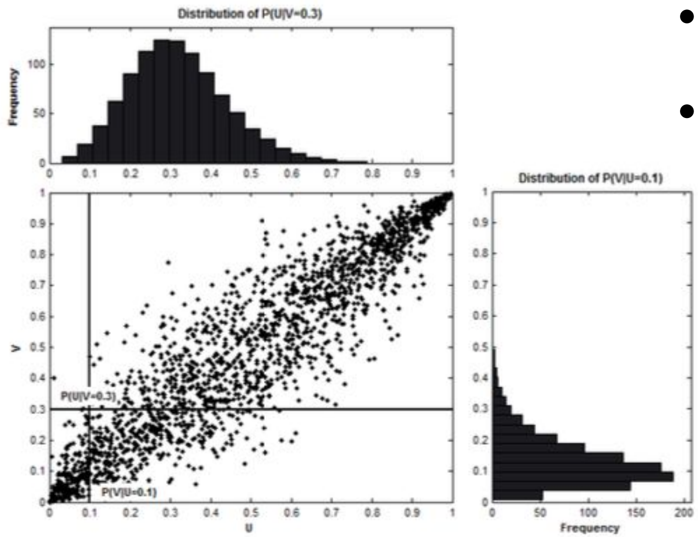
Table 1: EQUAL WEIGHTED TopkDropoutStrategy

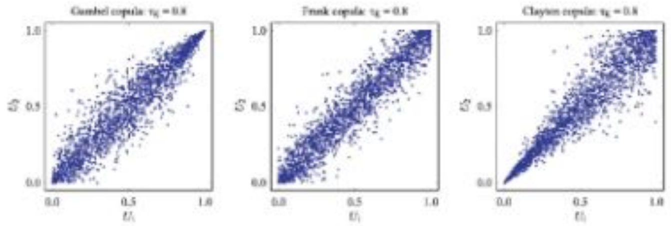
| | Sharpe Ratio | Max Drawdown | Compounding Annual Return |
|---|---|---|---|
| IS 2017.1.1-2021.1.1 | 0.693 | 34.20% | 18.07% |
| OS 2016.1.1-2017.1.1 | 0.576 | 10.500% | 10.297% |
| OS 2022.1.1-2022.11.1 | -0.663 | 23.00% | -18.89% |
| OS 2023.3.10-2023.10.10 | -0.344 | 10.70% | -1.44% |

Table 2: Inverse-Variance Weighted TopkDropoutStrategy

# Strategy 2: Pairs Trading with Copula Mispricing Index

# Copula Mispricing Index Signal




- **Copula Definition:**

$$P(U_1 \le u_1, U_2 \le u_2) = C(u_1, u_2)$$

- **Single Day Mispricing Index Signal:**

$$\mathbb{MI}^{X|Y} = \frac{\partial C(u_1,u_2)}{\partial u_2} = \mathbb{P}(U_t^X \le u_t^X | U_t^Y = u_t^Y)$$
$$\mathbb{MI}^{Y|X} = \frac{\partial C(u_1,u_2)}{\partial u_1} = \mathbb{P}(U_t^Y \le u_t^Y | U_t^X = u_t^X)$$

- **Cumulative Mispricing Index Signal:**

$$\text{Flag}X^*(t) = \text{Flag}X^*(t-1) + (MI_t^{X|Y} - 0.5)$$
$$\text{Flag}Y^*(t) = \text{Flag}Y^*(t-1) + (MI_t^{Y|X} - 0.5)$$

**Open Rules:**

- When FlagX reaches 0.5 or FlagY reaches -0.5, short X and buy Y.
- When FlagX reaches -0.5 or FlagY reaches 0.5, short Y and buy X.

**Exit Rules:**

- If trades are opened based on FlagX, then close if FlagX reaches ±2.
- If trades are opened based on FlagY, then close if FlagY reaches ±2.

**Once Exit, we will set all the flag to 0.**

| Name of copula | Bivariate copula $C_\theta(u,v)$ | Tail Dependence |
|---|---|---|
| Clayton | $\left[\max\{u^{-\theta} + v^{-\theta} - 1; 0\}\right]^{-1/\theta}$ | Lower Tail Dependence |
| Frank | $-\frac{1}{\theta}\log\left[1 + \frac{(\exp(-\theta u)-1)(\exp(-\theta v)-1)}{\exp(-\theta)-1}\right]$ | No tail dependence but stronger in the center |
| Gumbel | $\exp\left[-\left((-\log(u))^\theta + (-\log(v))^\theta\right)^{1/\theta}\right]$ | Upper Tail Dependence |

# Stock Selection

**Selection Range:** ETF and Stocks from MorningStar Sectors

**Fundamental Analysis:** Select Top 10 Market Cap Stocks from each sectors and construct trading pairs with similar business scope

**Statistical Tests:**

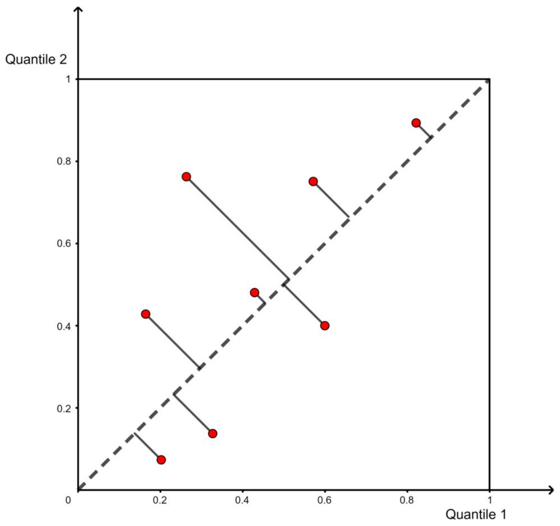
- Augmented Dickey-Fuller Test

$$H_0 : \rho = 1\text{: Non-Stationarity}$$
$$H_1 : \rho < 1\text{: Stationarity}$$

- Mangold's Test

$$H_0 : \theta = 0\text{: No Tail Dependency}$$
$$H_1 : \theta \neq 0\text{: Tail Dependency}$$

- Quantile-Quantile Distance Verification




**Stock Selected:**
**AAPL META, USB WFC, ABBV BMY, PPG CHRCY**

# Strategy Execution & BackTest Results

- **Fitting the copula** - Happens at the first day of each month

  We use the historical 125 days returns data fit an empirical marginal density distribution. Meanwhile, we will use the same historical datasets to select an optimal copula for each trading pairs.

- **Calculating Mispricing Index** - Happens on everyday market open
- **Order Execution** - Happens on everyday market open



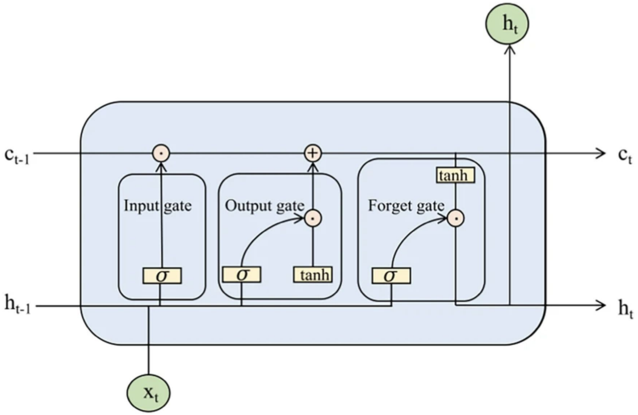
| | Sharpe Ratio | Max Drawdown | Compounding Annual Return |
|---|---|---|---|
| IS 2017.1.1-2021.1.1 | 0.532 | 13.800% | 10.220% |
| OS 2016.1.1-2017.1.1 | 0.323 | 12.200% | 5.098% |
| OS 2022.1.1-2022.11.1 | 2.166 | 13.200% | 59.643% |
| OS 2023.3.10-2023.10.10 | 0.831 | 4.5% | 16.894% |
| ST 2020.3 | 1.567 | 7.800% | 55.267% |

# Strategy 3: A2C model with LSTM Agents

# Long Short Term Memory (LSTM)

- Avoid vanishing gradient problem
- Make decisions based on both long-term and short-term information
- Filter out irrelevant information

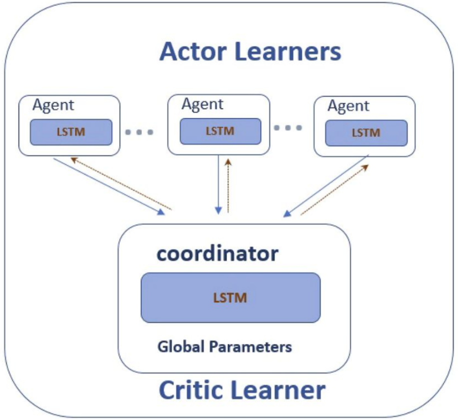
- *Suitable for financial data analysis!*




## ***Restrictions of LSTM***

- *Overfitting Stock Market Volatility*
- *Stationarity Input Data*
- *Sensitive to Influence of External Factors*
- *Results: Unstable and high volatility of trading performance*

# Advantage Actor Critic (A2C) Trading




- **State *s* :** information about the current environment;
- **Action *a*:** the action based on the current state(buy/sell/hold several shares of each stocks);
- **Actor learner:** producing the probability distribution for action ***a*** given the current state ***s*** ;
- **Critic Learner:** estimates the expected value(rewards) for the given state s;
- **Rewards *r* :** maximization target of the problem. Defined as ***PnL*** (profit and loss)of the portfolio between time ***t*** and ***t-1***.

## Stock Selection

- JPM
- BRK.B
- AAPL
- AMZN
- MSFT

Top 5 stocks sorted by Maket Cap selected from Financial Service, Consumer Service and Technology Sectors.

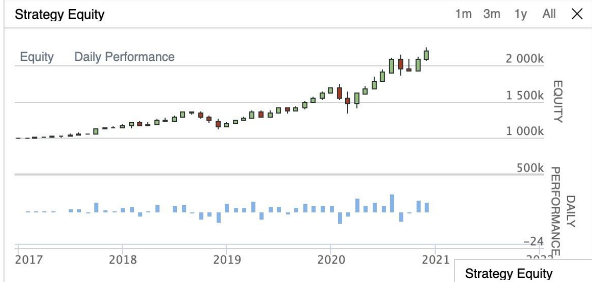
## Indicator Selection

- Relative Strength Index (RSI)
- Autoregressive Integrated Moving Average (ARIMA)
- Volatility
- Relative Daily Volume (RDV)
- Bandwidth
- Percent B (%B)
- Momentum (MOM)

*Model Training Period: 2017.1.1 - 2021.1.1*
*Trading Frequency: Every 10 trade days*

# Backtesting Results

| | Sharpe Ratio | Max Drawdown | Compounding Annual Return |
|---|---|---|---|
| IS: 2017.1.1-2021.1.1 | 0.997 | 21.50% | 21.80% |
| OS:2016.1.1-2017.1.1 | 1.817 | 6.20% | 17.50% |
| OS:2022.1.1-2022.11.1 | -0.346 | 14.70% | -4.85% |
| OS:2023.3.10-2023.10.10 | 0.610 | 6.20% | 4.788% |
| Stress Testing:2020.3 | -1.438 | 1.00% | -6.76% |




In Sample Period:2017.1.1-2021.1.1


Out of Sample Period:2016.1.1-2017.1.1


Live Trading:
12.7-12.12

Out of Sample Period:2023.3.10-2023.10.10


Out of Sample Period:2022.1.1-2022.11.1

# Strategy 4: ChatGPT Sentiment

# Advantages of GPT

- **Advantages of GPT in sentiment analysis**
  - Training Free
  - High Accuracy
  - Customization
  - Intepretability
- **Prompt Engineering**

You will work as a Sentiment Analysis Expert for Financial News for Apple, focusing on financial indicators such as earnings, market trends, and investor opinions. Your answer will include 2 lines. In the first line, you will answer 1 sentence to analyze why the news is good or bad for Apple. Then, in the second line, you will answer with an integer between 1 and 10, with 1 being most BEARISH, 10 being most BULLISH.

Role Assignment

Focus on Relevant Factors

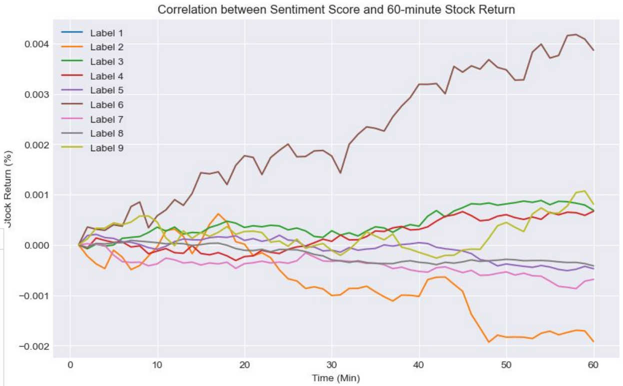
Structured Response Format

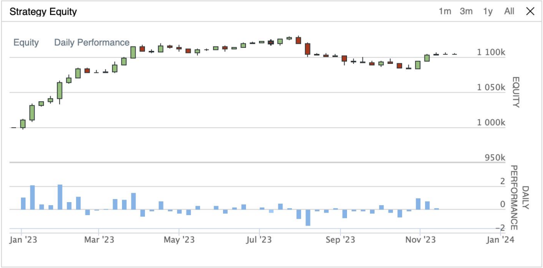
Analytical Reasoning

Clear Sentiment Ratings

# Key Findings and Trading Strategy

- **EDA Key Findings:**
  - Correlation between news sentiment and stock returns in next 60 minutes.
  - Label 2 indicates strong return decrease
  - Label 6 indicates strong return increase
- **Addressing LookAhead Bias:**
  - GPT-3.5-turbo: Up to Sep 2021
  - Backtesting: From Jan 2022
- **Out-Of-Sample Result (2023.1.1 - 2023.12.1):**
  - Annual Return: 11.467%
  - Sharpe Ratio: 0.728
  - Max Drawdown: 4.200%

# Portfolio Construction & Risk Management

# Optimize Portfolio Risk Using Risk Parity

1. **Calculate Volatility:** historical volatility for each asset.
2. **Generate Covariance Matrix;**
3. **Calculate Risk Contribution:** $RC_i = w_i \cdot \sigma_i \cdot \sum_{j=1}^{N} w_j \cdot c_{ij}$; where ***w_i*** is the weight of asset ***i***
4. **Optimization Algorithm:** $\min_{\mathbf{w}} \left\{ \sum_{i=1}^{N} \left( RC_i - \frac{1}{N} \right)^2 \right\}$
5. **Measure Leverage:** Adjust the portfolio weights to achieve the targeted risk parity condition by applying leverage to the assets accordingly.

# Portfolio Performance

## Equal Weights Asset Allocation

| | Sharpe Ratio | Max Drawdown |
|---|---|---|
| IS 2017.1.1-2021.1.1 | 1.34 | 17.14% |
| OS 2016.1.1-2017.1.1 | 1.27 | 4.97% |
| OS 2022.1.1-2022.11.1 | 0.84 | 10.08% |
| OS 2023.3.10-2023.10.10 | 1.37 | 5.5% |

Table 7: Portfolio Statistics

## Risk Parity Asset Allocation

| | Sharpe Ratio | Max Drawdown |
|---|---|---|
| IS 2017.1.1-2021.1.1 | 1.34 | 14.76% |
| OS 2016.1.1-2017.1.1 | 1.13 | 4.97% |
| OS 2022.1.1-2022.11.1 | 1.12 | 4.97% |
| OS 2023.3.10-2023.10.10 | 1.41 | 4.64% |

Table 8: Portfolio Statistics

# Thank You!