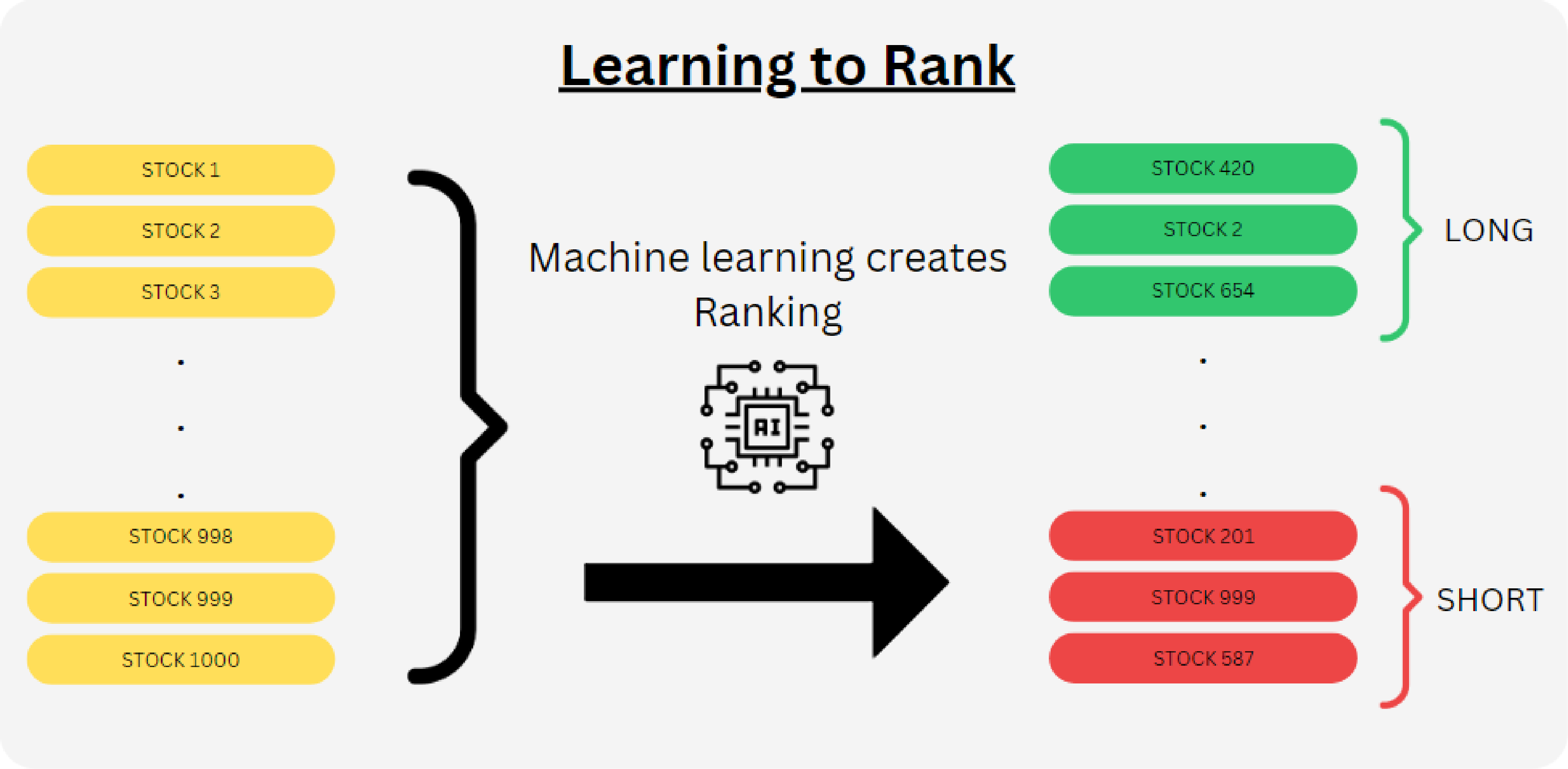
LEARNING TO RANK

A Machine Learning Approach to Rank Assets

- What is Learning to Rank (LTR)?
- How to use Learning to Rank for trading strategies
- Results
- Next Steps

Learning to Rank in Finance



Trading Strategy Steps

Data Collection and Processing → **Train Predictive Models** → **Assets Selection and Portfolio Construction**

Data Collection and Processing

- Collect and clean/check data
- Create input features
- Data transformations
- Data exploration

Train Predictive Models

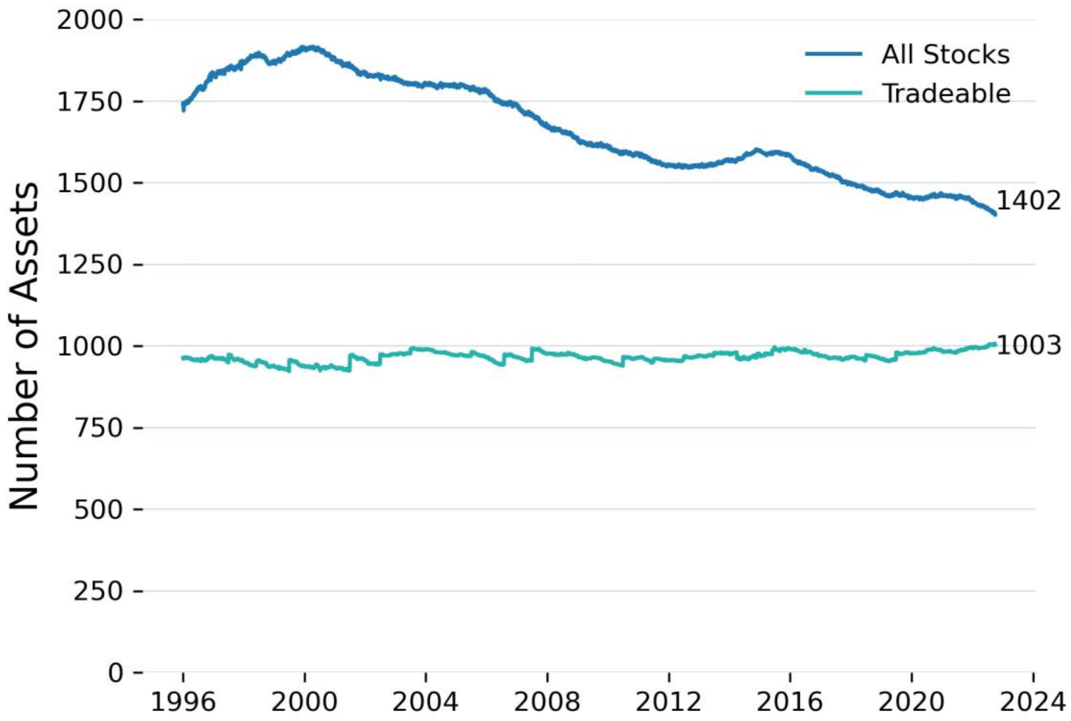
- Train predictive models to get predictions

Assets Selection and Portfolio Construction

- Construct portfolios using the predictions
- Position sizing

Data Description

- Universe: constituents **Russell 1000 from 01/01/1995 – 04/10/2022**
- Daily pricing data for **3250 stocks:**
  - Open, High, Low, Close, Volume, Market Cap
- **Price and volume derived features** over several periods
- **Over 12.250.000 rows** and over **100 columns**
- **Tradeable:** stocks considered to be part of Russell 1000 at time *t*



Data Transformation and Preprocessing

Raw Data

Create Predictors

Examples:

- Return
- Sharpe ratio
- Volume
- Technical indicator such as MACD, RSI …

Create Targets

Examples:

- Forward Return
- Forward Sharpe ratio (SR)
- …

Data Preprocessing

- Cross-sectional ranking
- Handling outliers
- Handling missing values

- Features computed on several horizons
  - - e.g. Past Returns over 5, 10, 20, 60 days
- Missing values: cross sectional imputation with the mean
- Normalization: cross-sectional ranking
  - Automatically handles outliers

Backtesting Setup

Models Presented

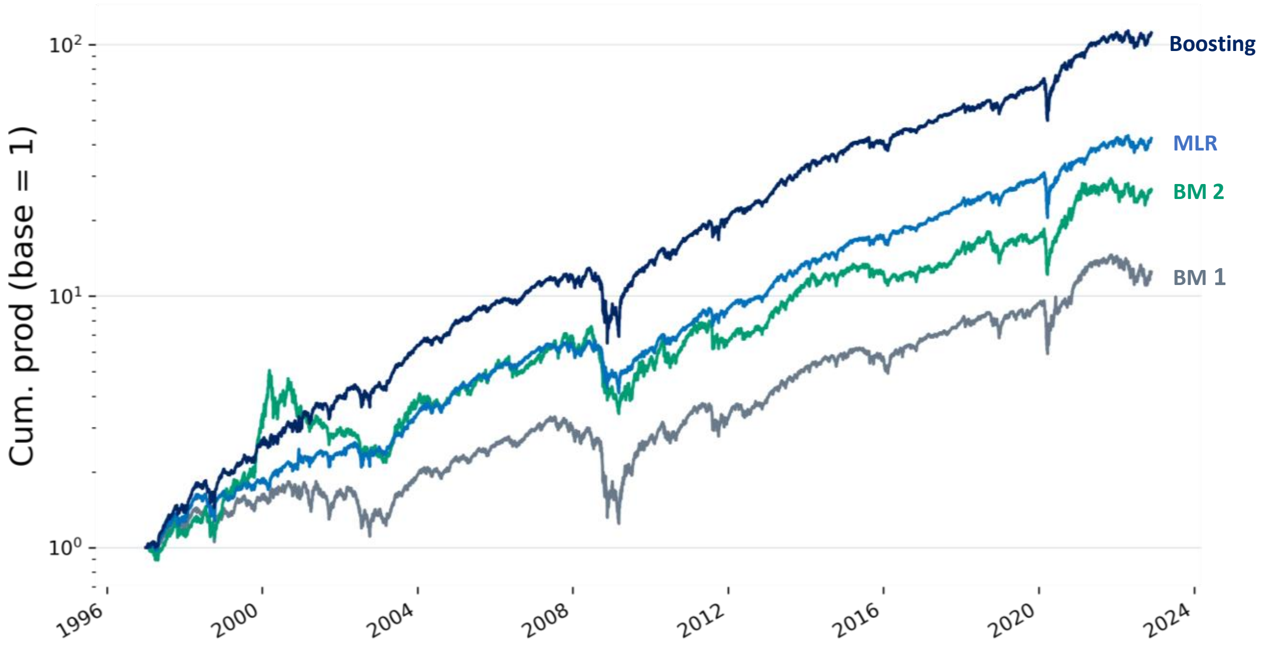
- **Benchmark:**
  - equal weighted of all tradeable stocks in the universe (Russell 1000)
  - One-Factor momentum strategy based on the return over 1, 3, 6, 12 months
- **Learning to Rank Models (LTR)**
  - Multiple Linear Regression (MLR)
  - Regression Trees (Reg Trees)
  - No Hyper parameter tuning

Configurations

- **Universe:** constituent Russell 1000 at time *t*
- **Prediction:** *relative* 10 day forward Sharp Ratio (*SR)*
- **Expanding walk forward:**
  - 1996 - 2022
  - Minimum train period: 1 year
  - Test period: 1 year
- **Rebalancing Period and Allocation process:**
  - Russell 1000: bi-monthly and equal weighted
  - One-Factor momentum: monthly and equal weighted
  - LTR models: bi-monthly and rank-vol weighting
  - Max weight per stock 0.025

LTR Outperforms Benchmarks

Models Performances without Fees



Strategy	BM 1	BM 2	MLR	Boosting
Return (%)	10.76	13.96	15.54	**19.97**
Volatility (%)	20.8	23.22	15.62	**16.98**
Sharpe Ratio	0.52	0.60	0.99	**1.17**
Max DD (%)	62.43	57.02	37.96	**49.41**
Max TUW (Days)	865	1400	404	**345**

Key Takeaways

Strong consistent performance after transaction costs

- Signal is consistent over time
- More return
- Lower risk in terms of volatility and drawdown
- **Returns: 19,97% p.a. / Sharp Ration: 1,17**

Multifunctional and Generalizable

- Applicable on other targets (returns, volatility…)
- Applicable to other universes and asset classes (European, Asian… market)
- Intuitive to incorporate new predictive features or add more assets