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Deep Ensemble Networks for Momentum Portfolio Trading

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Motivation

Momentum trading has long been an area of research with much interest, with demonstrated evidences of persistent abnormal returns across time, markets and asset classes in the finance literature. Cross-section momentum focuses on relative performances of assets while Time-series momentum focuses on each asset's performance history, both attempts to capitalize on trend persistence of asset prices. There exists a wide variety of techniques and rules in the momentum trading literature but limited comparative evidence between them to support one over another. Thus, this work investigates a broad set of momentum features with the application of deep learning for complex non-linear relationship to construct momentum portfolios across a 10-year period on historical constituents of the S&P 500.

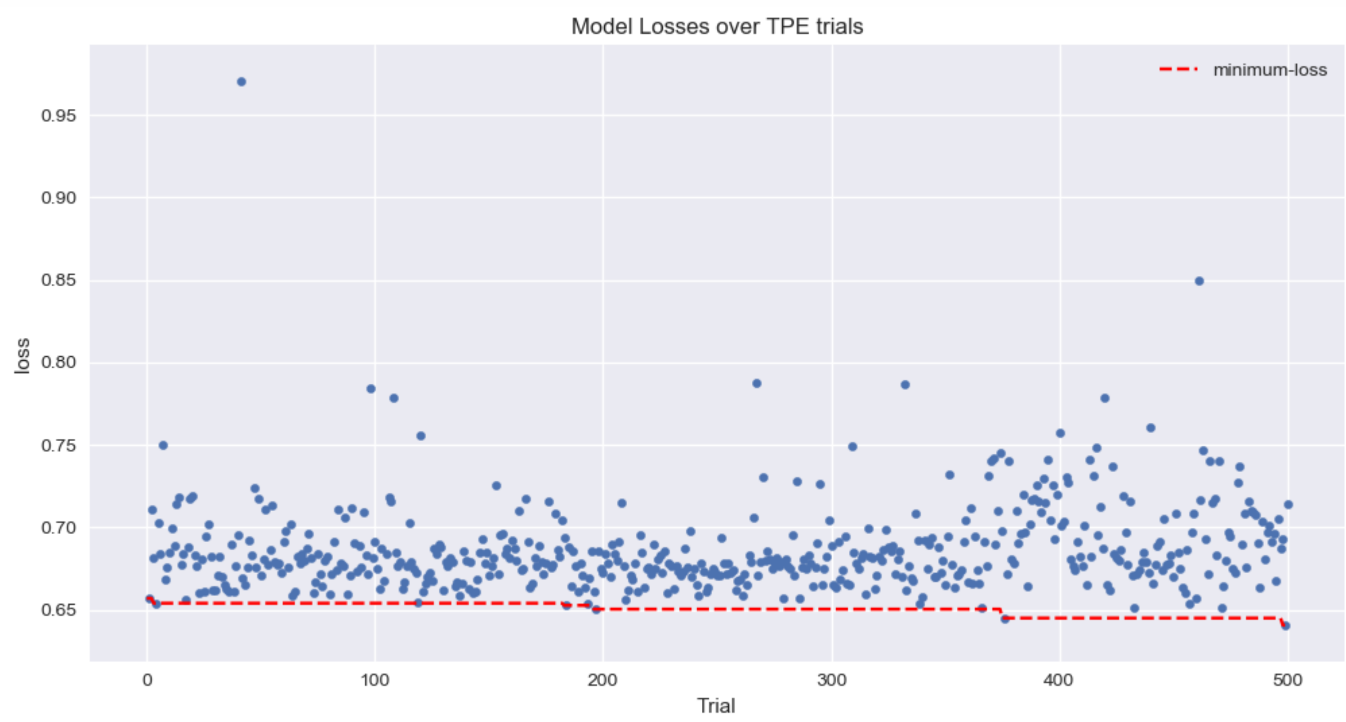
Momentum Features

- **Price Momentum:** Cumulative returns over look-back periods of 1 to 21 days and 42 to 252 days in increments of 1 and 21 days respectively.
- **Market State:** Average market returns and standard deviation of the returns over look-back periods of 10, 21, 42, 63, 126, 252, 378, 504 days.
- **Market Model:** Rolling regression on past returns of stock *i,* and the market, *m* for different look-back periods following market state, slope, intercept, standard error are employed as market beta, excess returns and idiosyncratic volatility respectively.
- **Information Discreteness:** $$ID_{i,p} = sign(R_{i,p})\frac{\% neg_{i,p} - \% pos_{i,p}}{\% neg_{i,p} + \% pos_{i,p}}$$

where p ∈ [t − 1, t − k] for k = [10, 21, 42, 63, ..., 252] days with R being the cumulative returns of stock *i* over the period *p* and *%neg, %pos* are the proportion of days with negative and positive returns respectively over period *p.*

Bayesian Optimization of Hyperparameters

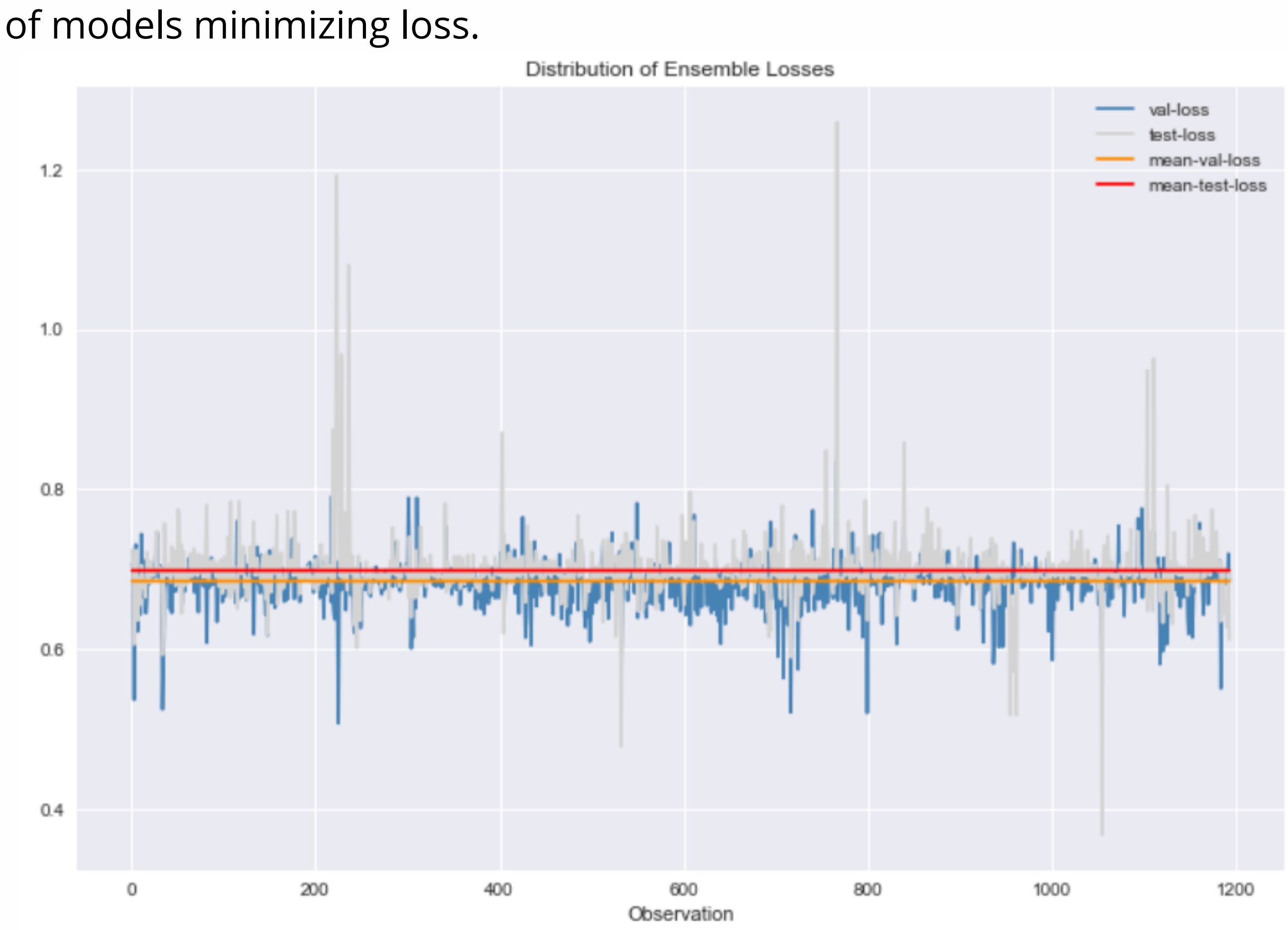
Bayesian sequential optimization using Tree-Structure Estimator (TPE) technique to tune models in an unsupervised fashion over a defined search space.



- TPE iterations produced model with **minimized loss** over time in an unsupervised and **scalable** fashion.

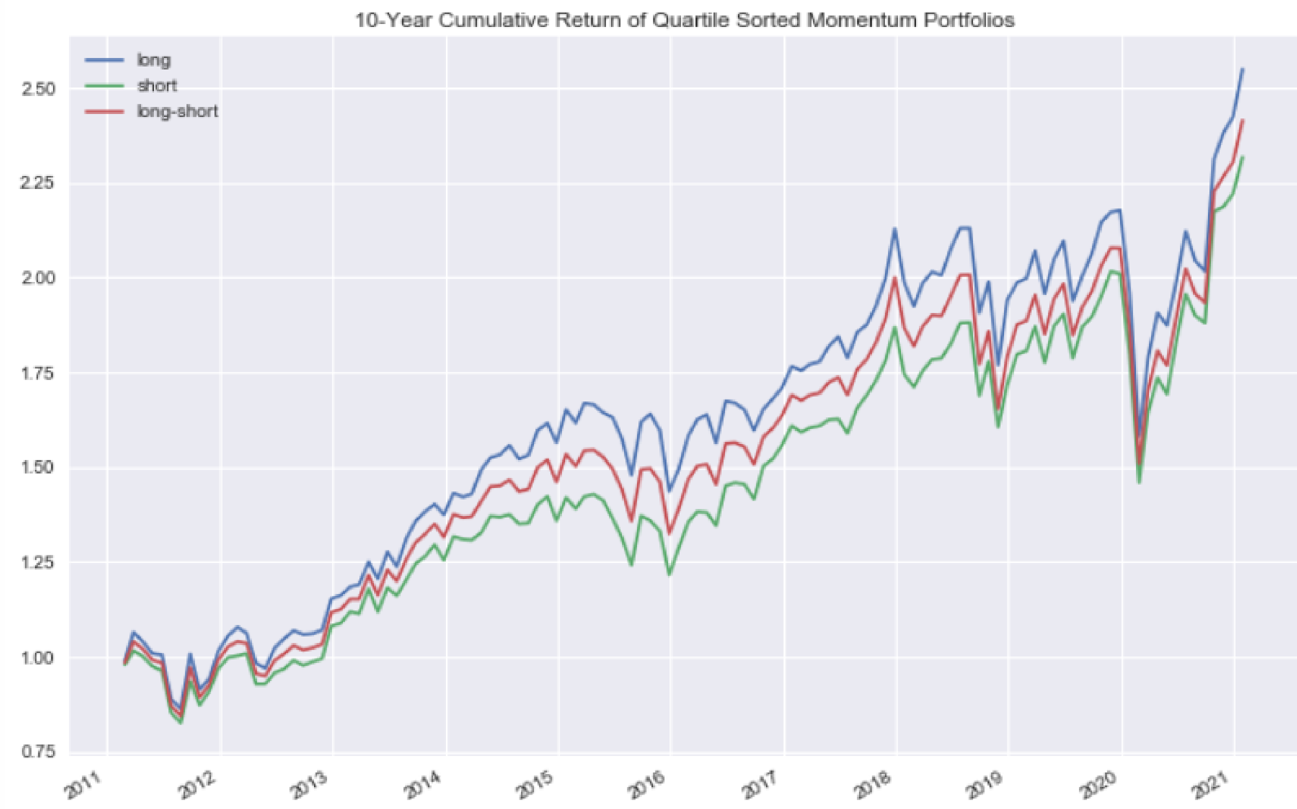
Ensemble Selection

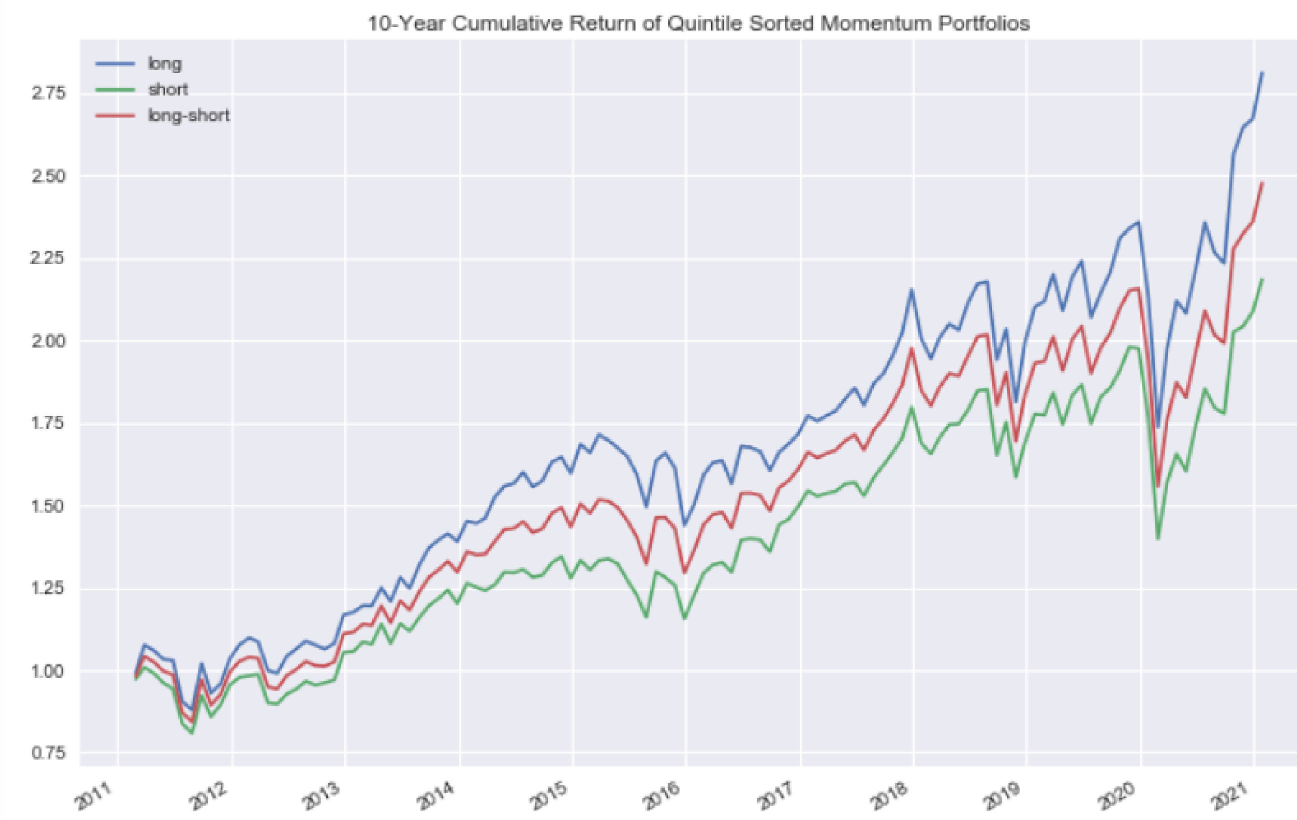
Models produced from TPE iterations are used collectively as a model library for ensemble selection of models minimizing loss.



- **Good generalization ability of the ensemble models with low variance** between validation and test losses.

Results and Analysis





- **Significant annualized returns between 8.63% - 10.89%** for Long- and Long-Short portfolios across sort type, **with average 15% and 40% lower downside risk** in terms of Maximum Drawdown and Maximum Month Loss respectively.
- Consistently **higher returns of Long-only portfolios over Long-Short** portfolios, **widening spread between Long-only and Short-only** portfolios across sort type, further providing evidence for **ineffectiveness of shorting for time-series momentum**.