Stock Portfolio Selection Using Two-tiered Lazy Updates

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What is the problem?

Problem: Group trends can be missed when prediction is based on changes of only the individual.

- Knowledge that can be gained from relationships between details is difficult to encode

What is the solution?

Solution: Use a two-tiered algorithm that adapts to individual trends at the bottom level and group trends at the top level

In Portfolio Selection:

- Individual stocks are picked at the low level
- Groups of stocks are picked at the high level
- Isolation of groups allows one stock to be in multiple groups
- Group examples: Tech, Medical, large-cap, blue chip, etc.

Online Portfolio Selection

The Lure of the Stock Market

By making an initial investment of $10 into the New York Stock Exchange in 1962, you could have made $367 million by 1984—requiring only 10 trades and $70's in brokerage fees. Predicting the perfect 10 trades is the virtually impossible challenge.

Portfolio Selection Research

In Online Portfolio Selection, a trader purchases a portfolio of assets (stocks, options, etc.) with a specific goal in mind—typically to maximize return on investment at a reasonable rate of risk.

Sector Level:

- Represent a sector portfolio at time *t* as a vector $\boldsymbol{q}_t$ of weights that correspond to the distribution of wealth between stocks in that sector

Market Level:

- Represent a portfolio at time *t* as a vector $\boldsymbol{p}_t$ of weights that correspond to the distribution of wealth between different sectors

The vectors $\mathbf{q}_t$ and $\mathbf{p}_t$ are determined before the relatives for the day are revealed.

Incorporating Risk

By passing a modified price relative that incorporates risk level for the sector over the last *d* days, we try to control risk levels:

$$\delta_t' = \frac{\prod_{i=t-d+1}^{t} \delta_i}{\max\{a, \sigma(\delta_{t-d+1:t})\}}$$

Two-tiered Online Lazy Updates

Sector Level Online Lazy Updates (SOLU)

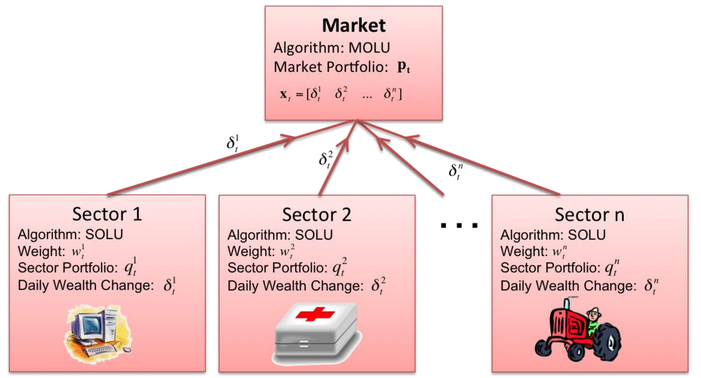
OLU objective function: $\mathbf{q}_{t+1} = \underset{\mathbf{p}\in\Delta_n}{\operatorname{argmin}} \; -\eta\log(\mathbf{q}^{\mathrm{T}}\mathbf{x}_t) + \alpha\|\mathbf{q}-\mathbf{q}_t\|_1 + \frac{1}{2}\|\mathbf{q}-\mathbf{q}_t\|_2^2$

where $\mathbf{x}_t$ is the vector of stock price relatives on day *t*

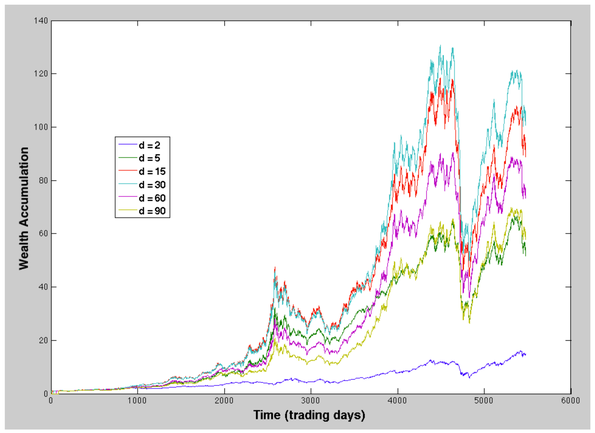
Market Level Online Lazy Updates (MOLU)

OLU objective function: $\mathbf{p}_{t+1} = \underset{\mathbf{p}\in\Delta_n}{\operatorname{argmin}} \; -\eta\log(\mathbf{p}^{\mathrm{T}}\mathbf{x}_t) + \alpha\|\mathbf{p}-\mathbf{p}_t\|_1 + \frac{1}{2}\|\mathbf{p}-\mathbf{p}_t\|_2^2$

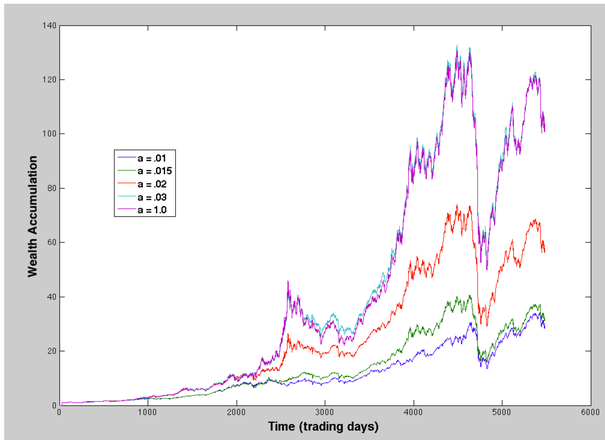
where $\mathbf{x}_t$ is the vector of SOLU price relatives on day *t*



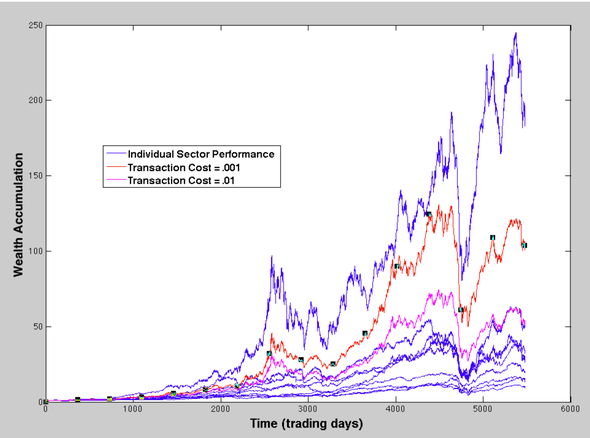
Results



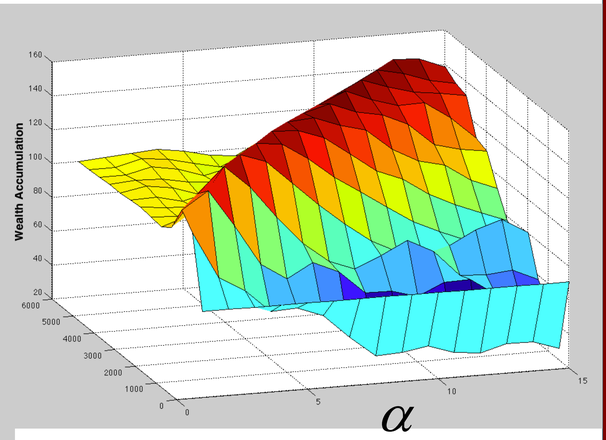
- At a transaction cost of 0.1%, 30 day periods provide the best balance between new and old information
- Low *d* -> focus on new High *d* -> focus on past



- Low risk misses opportunities for profit, but can reduce losses
- High risk follows extreme upswings and downswings



- We are able to compete with the top sector at 0.1% transaction cost
- Outperform 9/10 sectors at 1% transaction cost



- MOLU works best when η and α are in balance
- η too high -> too much trading
- α too high -> too conservative