

A laptop is shown on a wooden desk, displaying a website with a car image. A blue semi-transparent overlay covers the left side of the image. A large pink circle is positioned to the left of the main title.

# Portfolio Replication

Non-Negative LASSO

Business, Economics and Financial Data

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# TABLET OF CONTENT



## INTRODUCTION



## PASSIVE APPROACH

- Non-negative LASSO, Elastic Net, OLS
- Dynamic Model



## SHRINKAGE METHODS

- LASSO and Elastic Net



## ACTIVE APPROACH

- Shifted Windows
- Logistic Regression



## DATASET ANALYSIS

- Preliminary Analysis
- Parameter Estimation



## CONCLUSIONS

# INTRODUCTION

3

**WHAT IS PORTFOLIO REPLICATION?**

**WHICH APPROACHES?**

- Active
- Passive

**WHY LASSO?**

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# SHRINKAGE METHODS

# LASSO REGRESSION

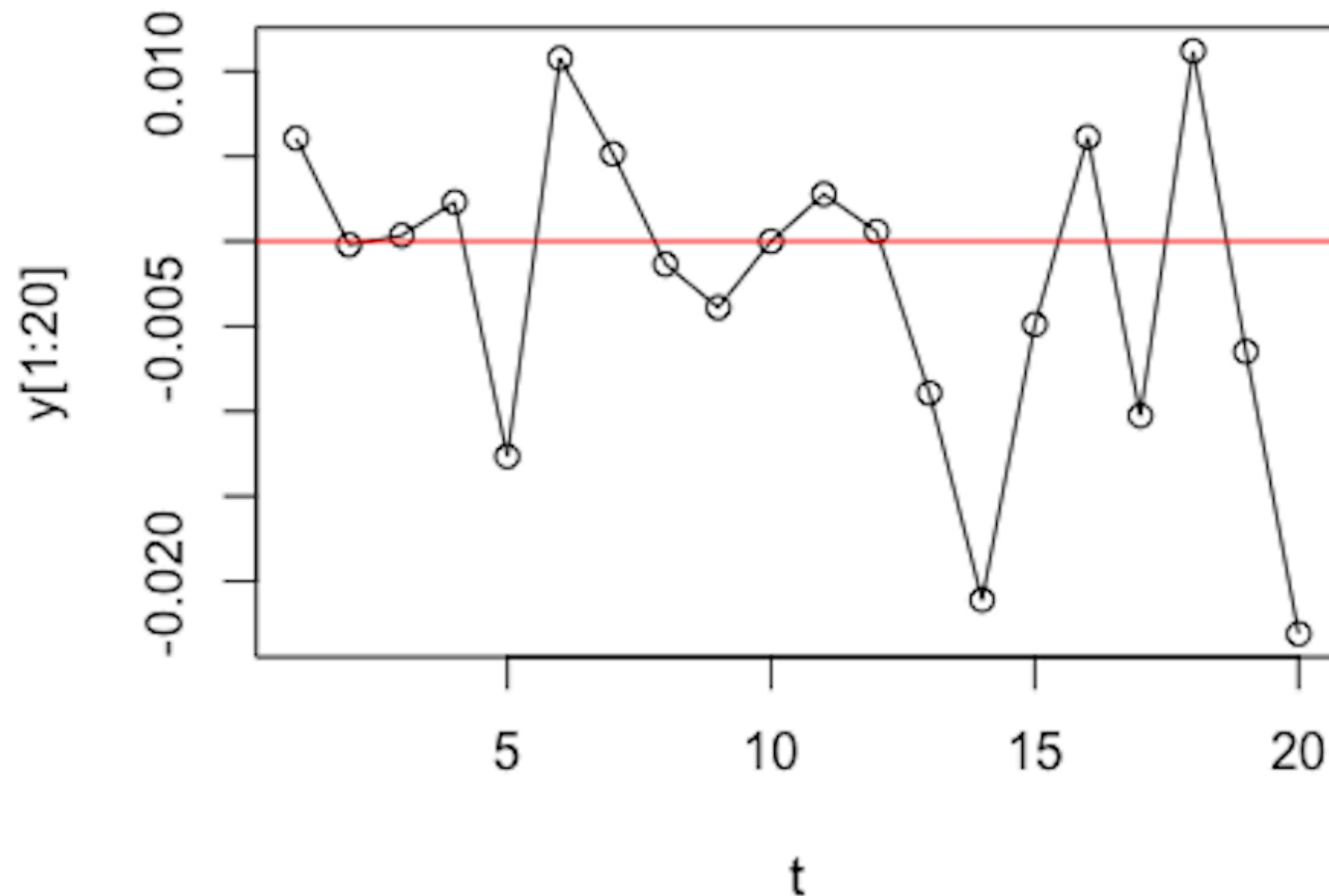
$$\min_{\boldsymbol{\beta}} \|\mathbf{y} - \mathbf{X}\boldsymbol{\beta}\| + \lambda \sum_{j=1}^p |\beta_j|$$

# ELASTIC NET REGRESSION

$$\min_{\boldsymbol{\beta}} \|\mathbf{y} - \mathbf{X}\boldsymbol{\beta}\| + \lambda \sum_{j=1}^p (\alpha \beta_j^2 + (1 - \alpha) |\beta_j|)$$

# DATASET ANALYSIS

# DATASET ANALYSIS



## What are we working on?

- Sp500 index
- Daily log returns

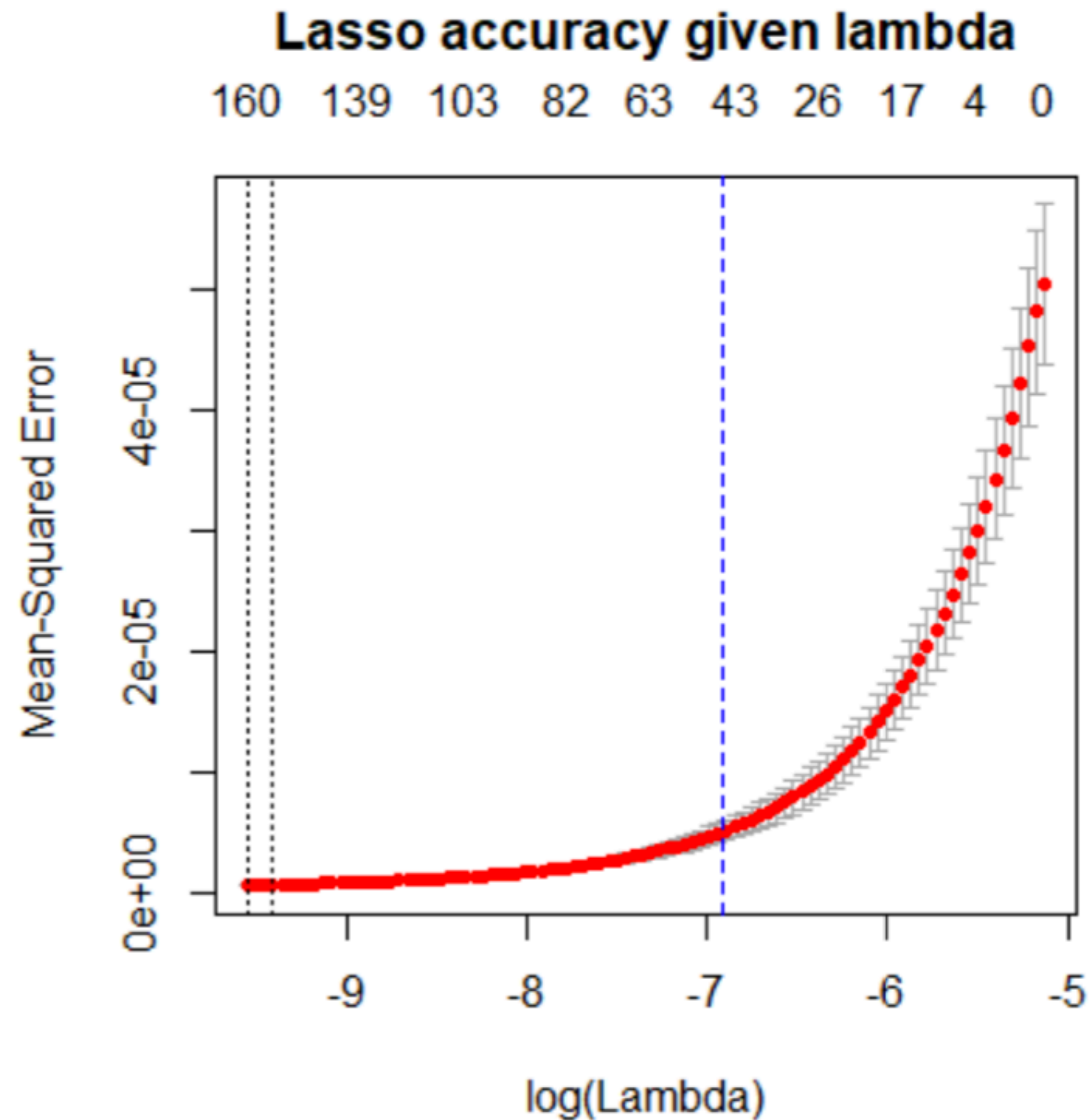
$$\log(y_{t+1}) - \log(y_t) = \log\left(\frac{y_{t+1}}{y_t}\right)$$

## Problems

- How to predict  $y_{t+1}$ ?



# PARSIMONY ↔ ACCURACY



## How to choose lambda?

Compromise between  
number of coefficients  
and prediction error



# PARAMETERS ESTIMATION

## Moving window approach

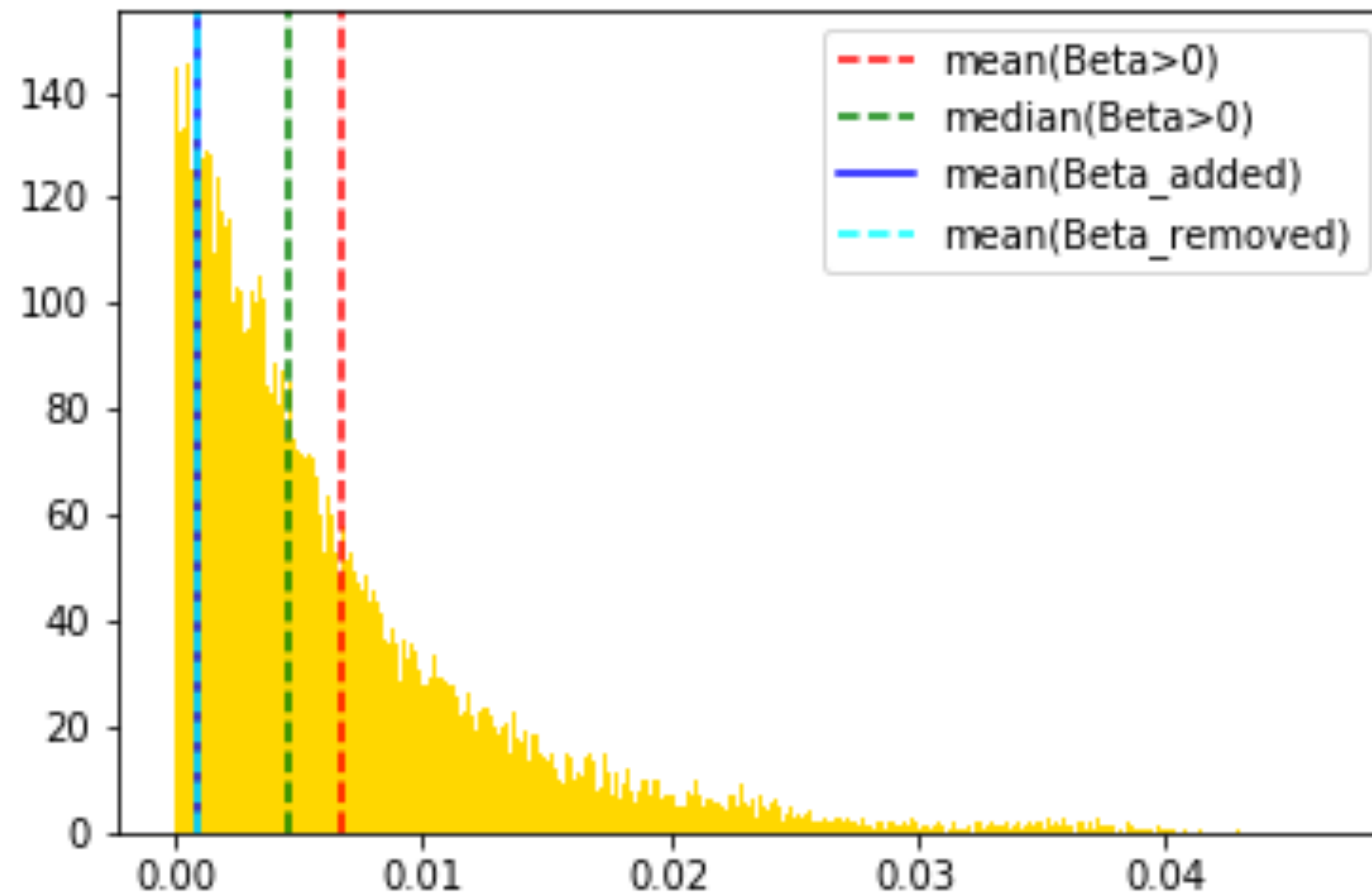
- Are beta coefficients time invariant?

## Beta-parameters interpretation

$$\log(y_{t+1}) - \log(y_t) = \log\left(\frac{y_{t+1}}{y_t}\right)$$

Sp500	APPLE	MICROSOFT	AMAZON.COM	EXXON.MOBIL
0.006063	-0.007184	0.007720	0.011116	0.014049
-0.000212	0.006318	-0.018014	0.009726	-0.003270
0.000348	-0.012855	-0.006453	-0.002267	-0.009776
0.002304	-0.006692	0.014252	-0.008389	0.007589
-0.012656	0.005221	-0.029853	-0.016941	-0.019793
0.010760	0.019702	0.022613	0.016639	0.005767
0.005153	0.019879	0.027021	-0.004209	-0.003436
-0.001348	-0.005596	0.003530	-0.000177	0.001618
-0.003903	-0.024807	-0.013921	0.009580	0.002221

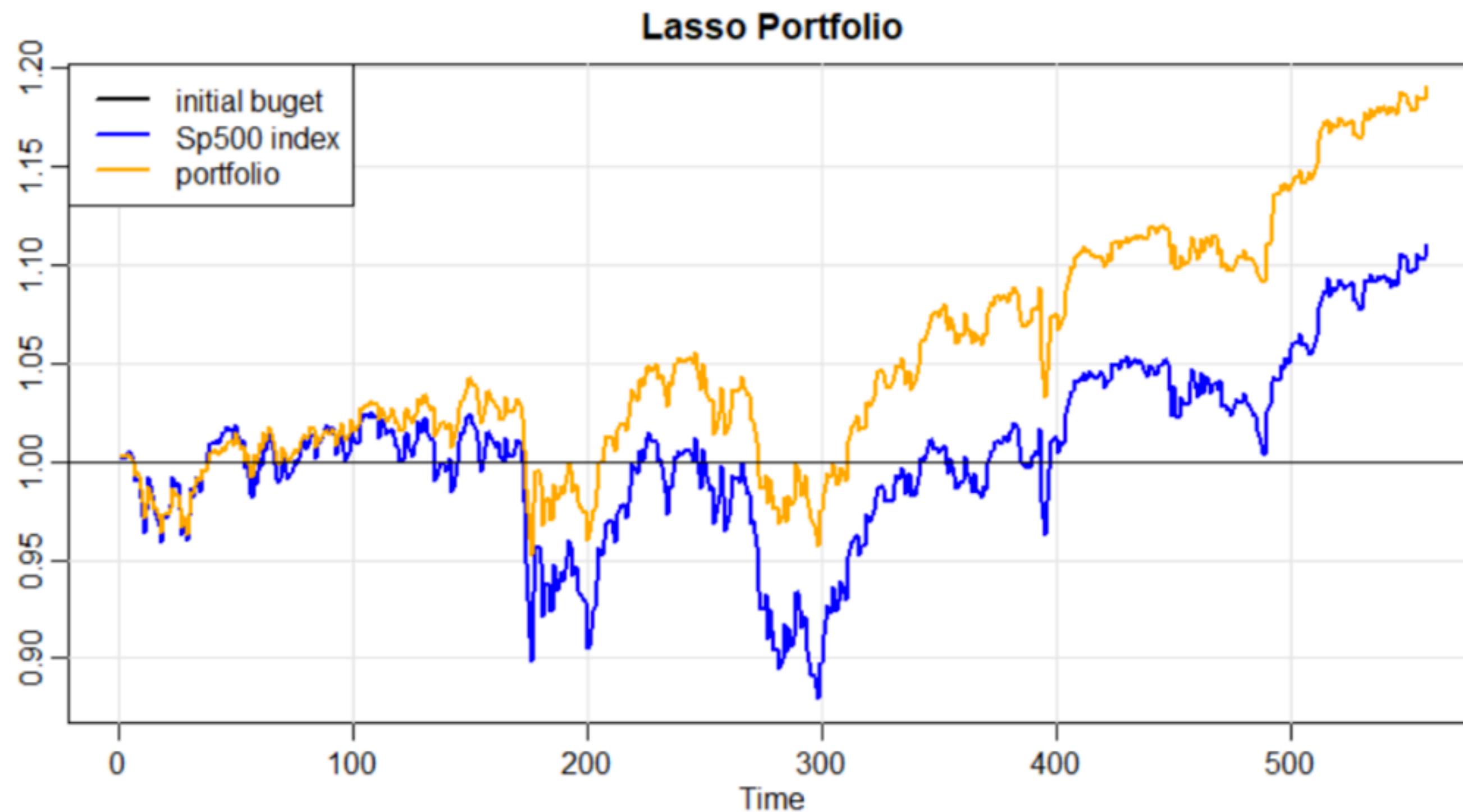
# BETA TURNOVER



- **Low turnover (4%)**
- **Added and removed variables have low weights (12%)**

# PASSIVE APPROACH

# LASSO REGRESSION



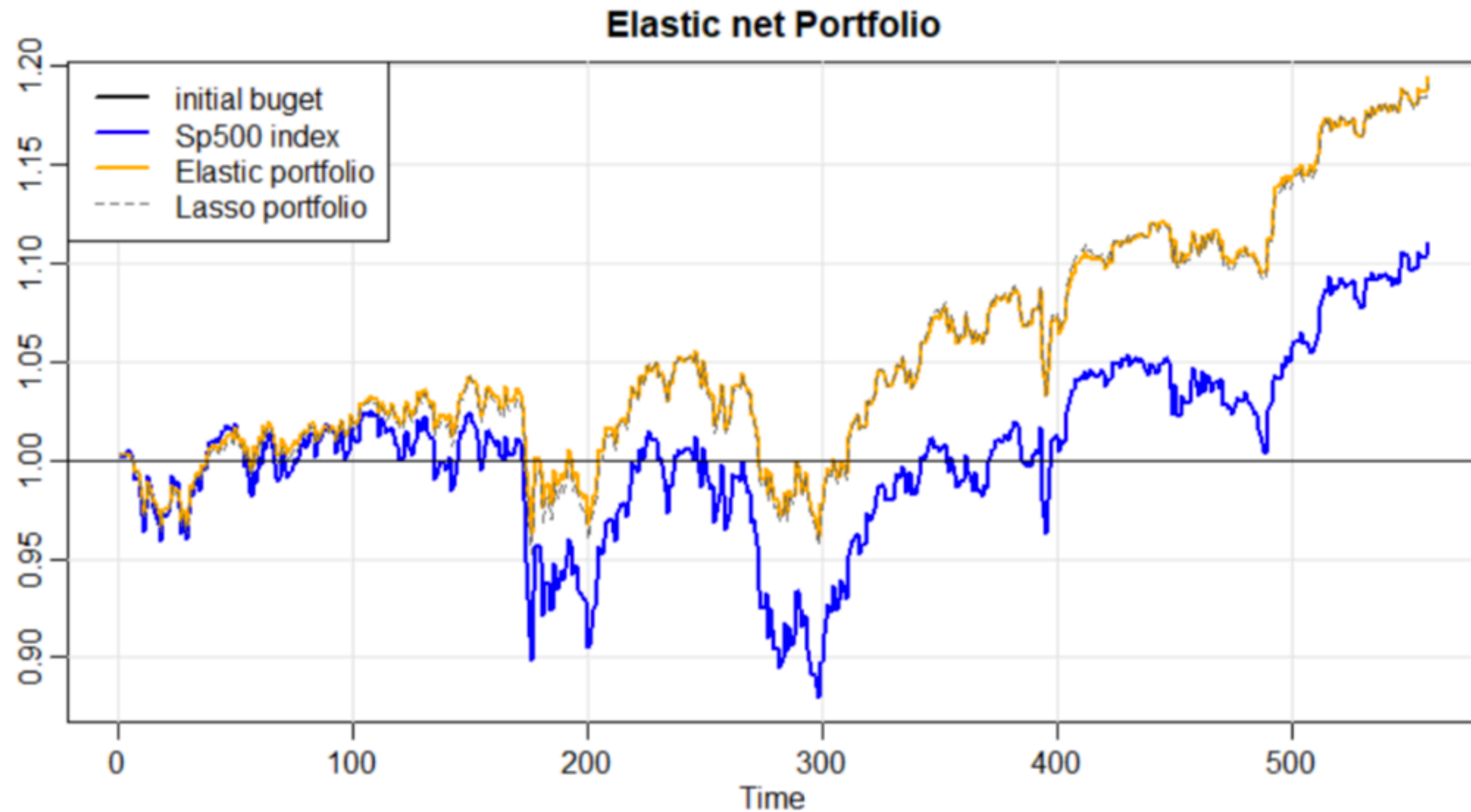
## PROs:

- Low Fees
- Growing Index ➡ Positive Returns

## CONs:

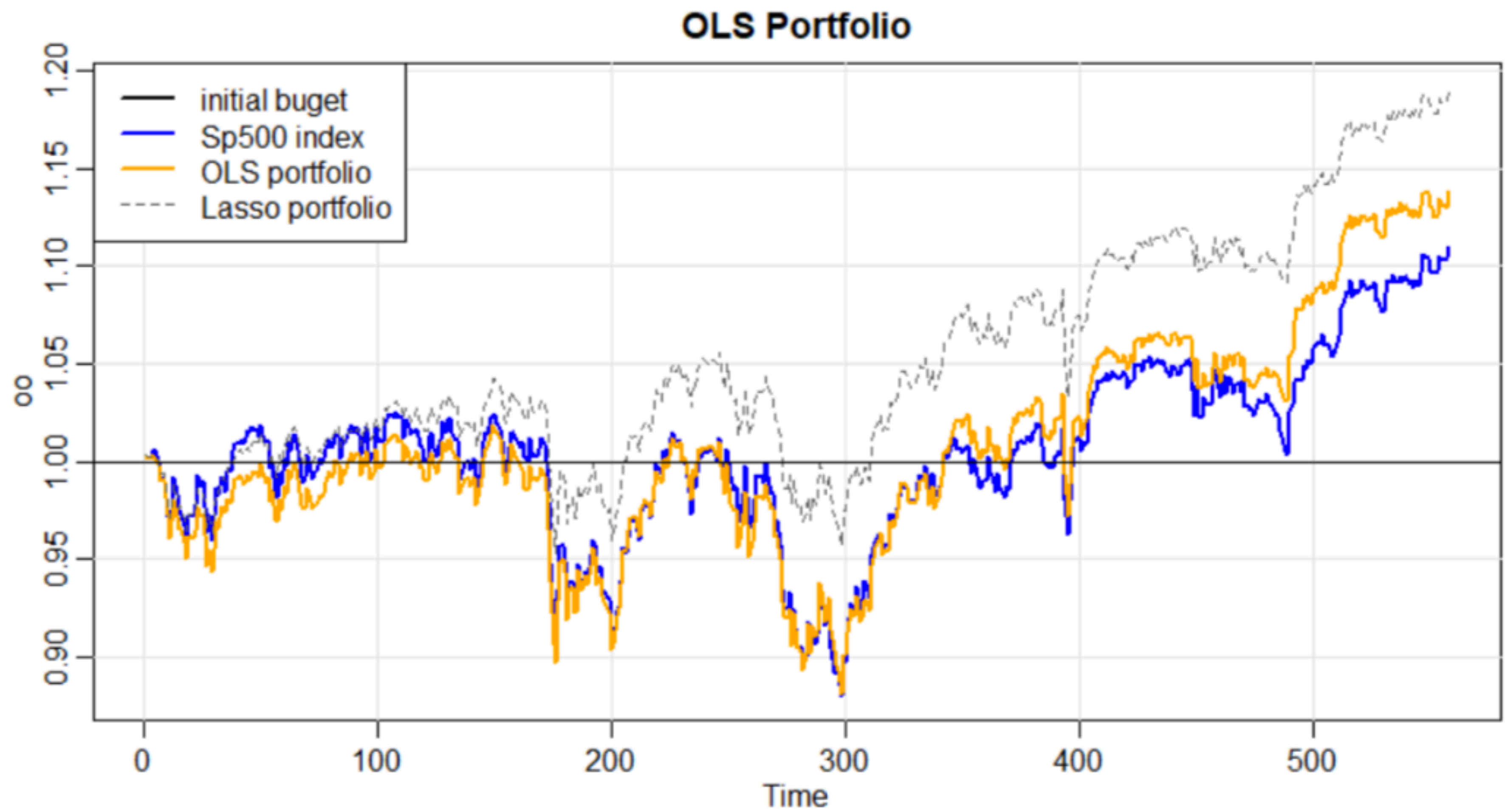
- How often update?
- Descending Index ➡ Losses

# ELASTIC NET REGRESSION



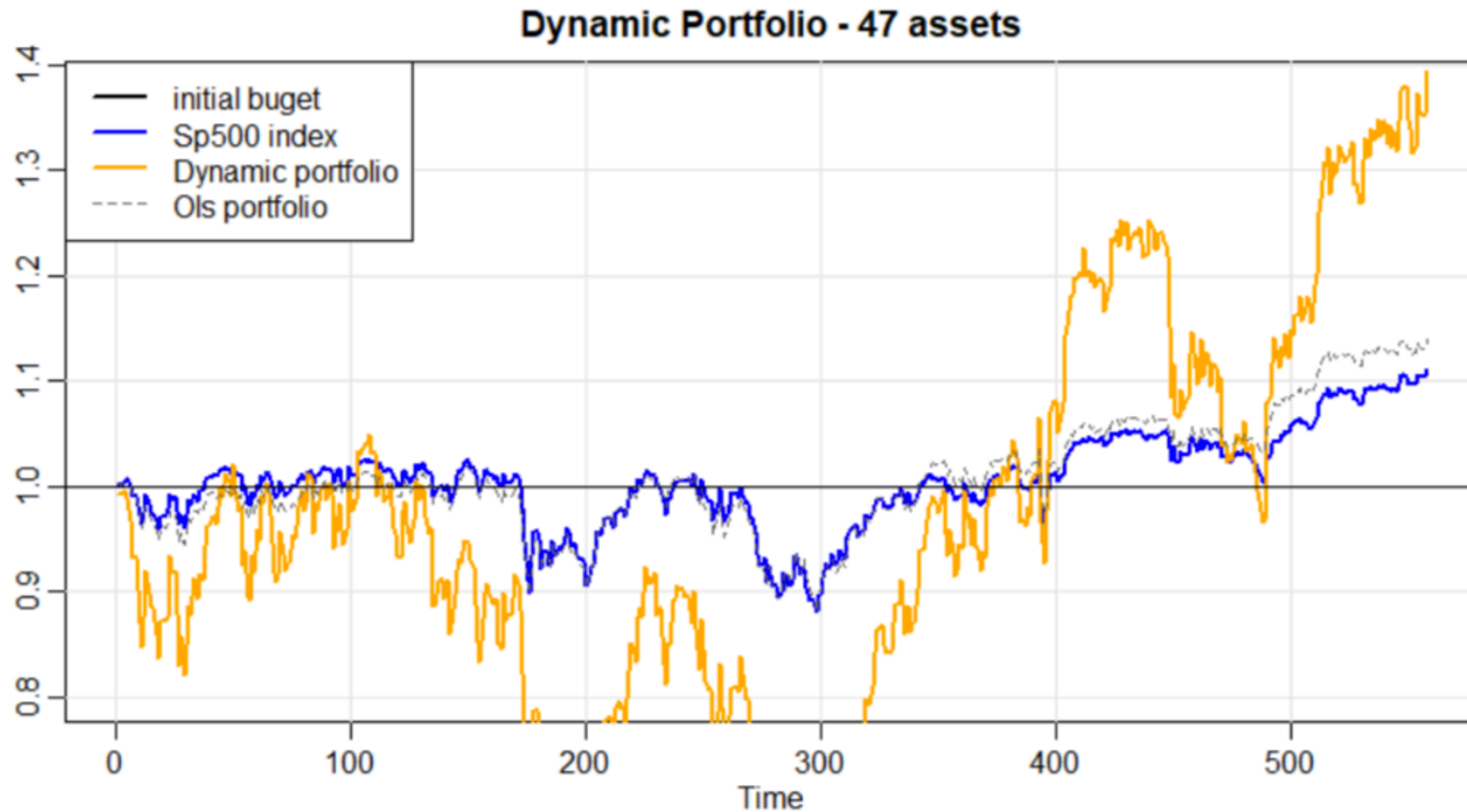


# OLS REGRESSION



# DYNAMIC REGRESSION

16



PASSIVE APPROACH

# ACTIVE APPROACH

# ONE STEP AHEAD PREDICTION

18

## Shifted windows approach

- Predictions are quite inaccurate
- Also time series approach not working

### PROs:

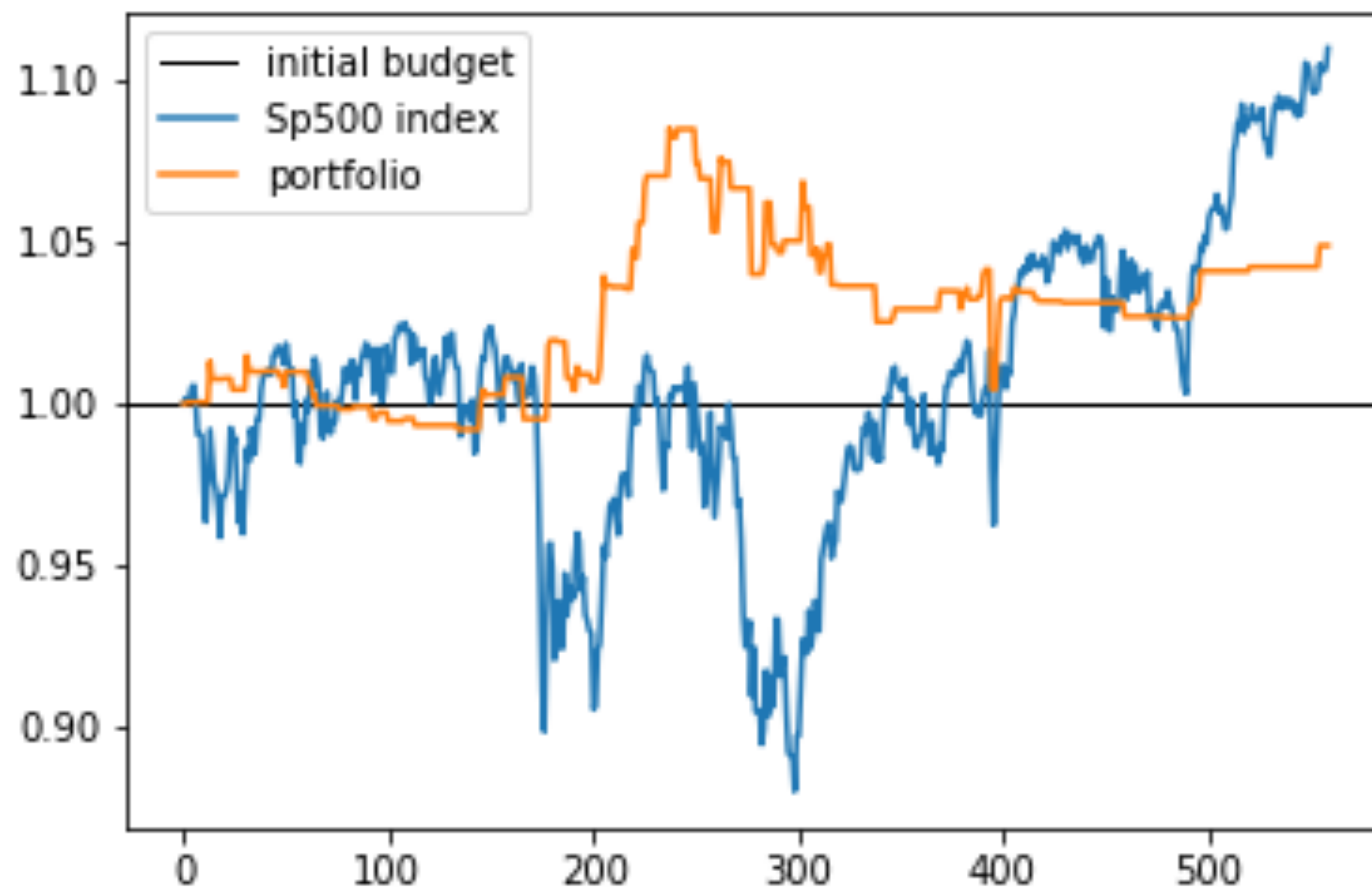
- Financial Strategy
- Possible high revenue

### CONs:

- High fees
- Possible huge losses even with growing index

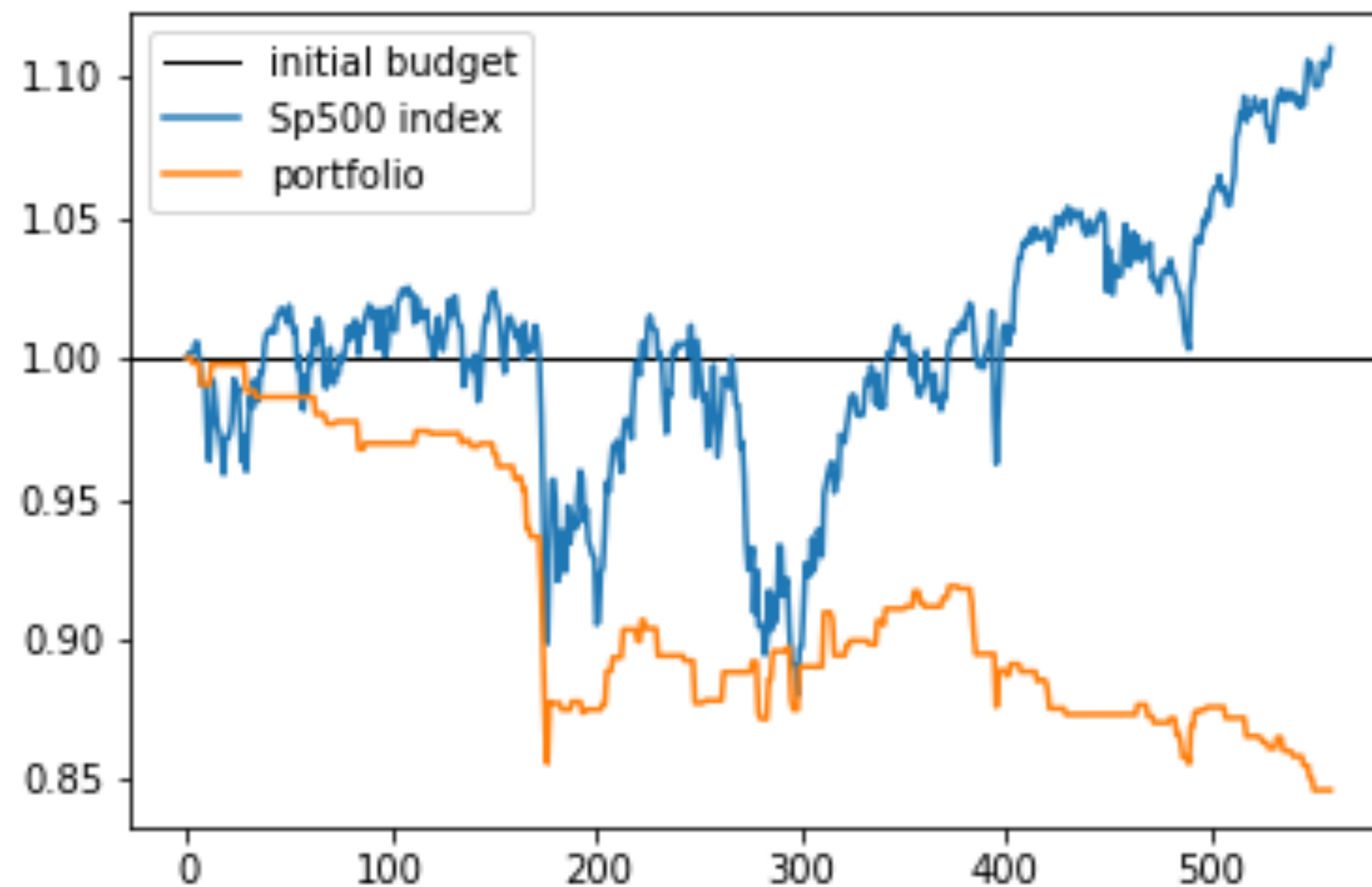
Sp500	APPLE	MICROSOFT	AMAZON.COM	EXXON.MOBIL
0.006063	-0.007184	0.007720	0.011116	0.014049
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-0.001348	-0.005596	0.003530	-0.000177	0.001618
-0.003903	-0.024807	-0.013921	0.009580	0.002221

# LASSO REGRESSION





# LOGISTIC REGRESSION





# CONCLUSIONS

- **Portfolio replication works quite well**
  - **Passive approach performs better than active**
  - **We need a better prediction model to exploit active approach**
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