FIN 580: Homework 2

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Introduction

VAR
- Implementation
- Results
- Discussion

VAR-Lasso
- Implementation
- Results
- Discussion

Ordered Lasso
- Implementation
- Results
- Discussion

KNN Regression
- Implementation
- Results
- Discussion

Outline

- Introduction
- VAR
  - Implementation
  - Results
  - Discussion
- VAR-Lasso
  - Implementation
  - Results
  - Discussion
- Ordered Lasso
  - Implementation
  - Results
  - Discussion
- KNN Regression
  - Implementation
  - Results
  - Discussion

Introduction

- We fit several models to 9 time series of currency data

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Introduction

- We fit several models to 9 time series of currency data
- We use MSE to compare model performance

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Introduction

- We fit several models to 9 time series of currency data
- We use MSE to compare model performance
- All analysis is performed in R

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Introduction

- We fit several models to 9 time series of currency data
- We use MSE to compare model performance
- All analysis is performed in R
- For purposes of this presentation, unless otherwise noted, MSEs are averaged across currencies as presenting them by currency as well proved visually overwhelming. The numbers for this, however, are available in our code if so desired.

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Data preprocessing

- Take log returns - day over day

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Data preprocessing

- Take log returns - day over day
- Take annualized daily standard deviations of these returns

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Data preprocessing

- Take log returns - day over day
- Take annualized daily standard deviations of these returns
- Change to log of vols

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Data preprocessing

- Take log returns - day over day
- Take annualized daily standard deviations of these returns
- Change to log of vols
- Instead of cleaning constants at the beginning - leading to data frame sizing compatibility issues - we check for 0 vols in modeling phases

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Data preprocessing

- Take log returns - day over day
- Take annualized daily standard deviations of these returns
- Change to log of vols
- Instead of cleaning constants at the beginning - leading to data frame sizing compatibility issues - we check for 0 vols in modeling phases
- Split train vs. test data - 3.5 yrs in train, 1.5 yrs in test

Implementation

- Package: vars

Introduction

VAR

Implementation
Results
Discussion

VAR-Lasso

Implementation
Results
Discussion

Ordered Lasso

Implementation
Results
Discussion

KNN Regression

Implementation
Results
Discussion

Implementation

- Package: vars
- Iterate through lags 1,2, and 3 - for each lag fit unregularized VAR model on all of train

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: vars
- Iterate through lags 1,2, and 3 - for each lag fit unregularized VAR model on all of train
- Use model for testing errors

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

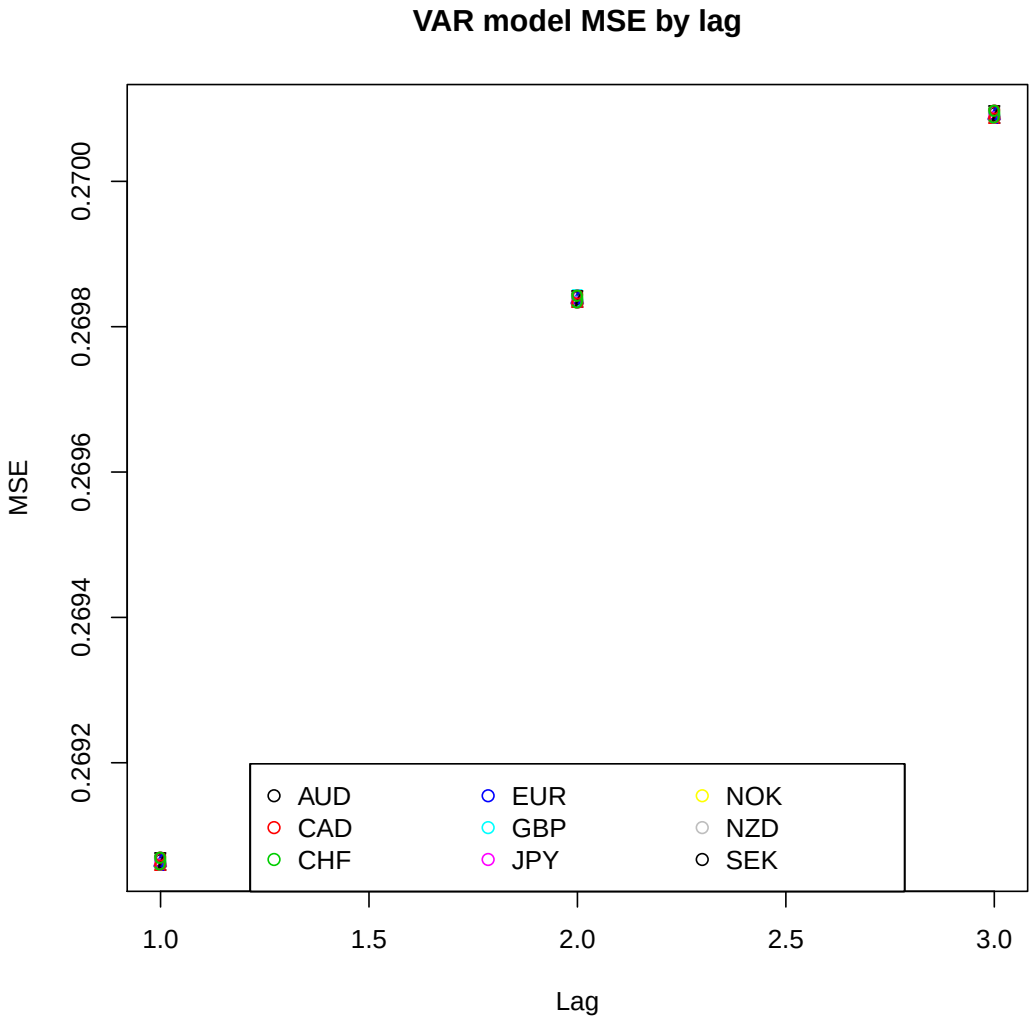

Figure: Average MSE by currency by lag

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Conclusions

- MSEs increase as a function of lag used

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Conclusions

- MSEs increase as a function of lag used
- Likely due to overfitting since we are not regularizing

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: BigVAR

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: BigVAR
- Iterate through lags 1,2, and 3 - for each lag fit model on all of train

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: BigVAR
- Iterate through lags 1,2, and 3 - for each lag fit model on all of train
- Cross-validate over training data to obtain an optimal lambda for each lag

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Implementation

- Package: BigVAR
- Iterate through lags 1,2, and 3 - for each lag fit model on all of train
- Cross-validate over training data to obtain an optimal lambda for each lag
- Use optimal lambda for each lag to fit regularized VAR models on expanding window for test predictions

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Implementation

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- Iterate through lags 1,2, and 3 - for each lag fit model on all of train
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Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

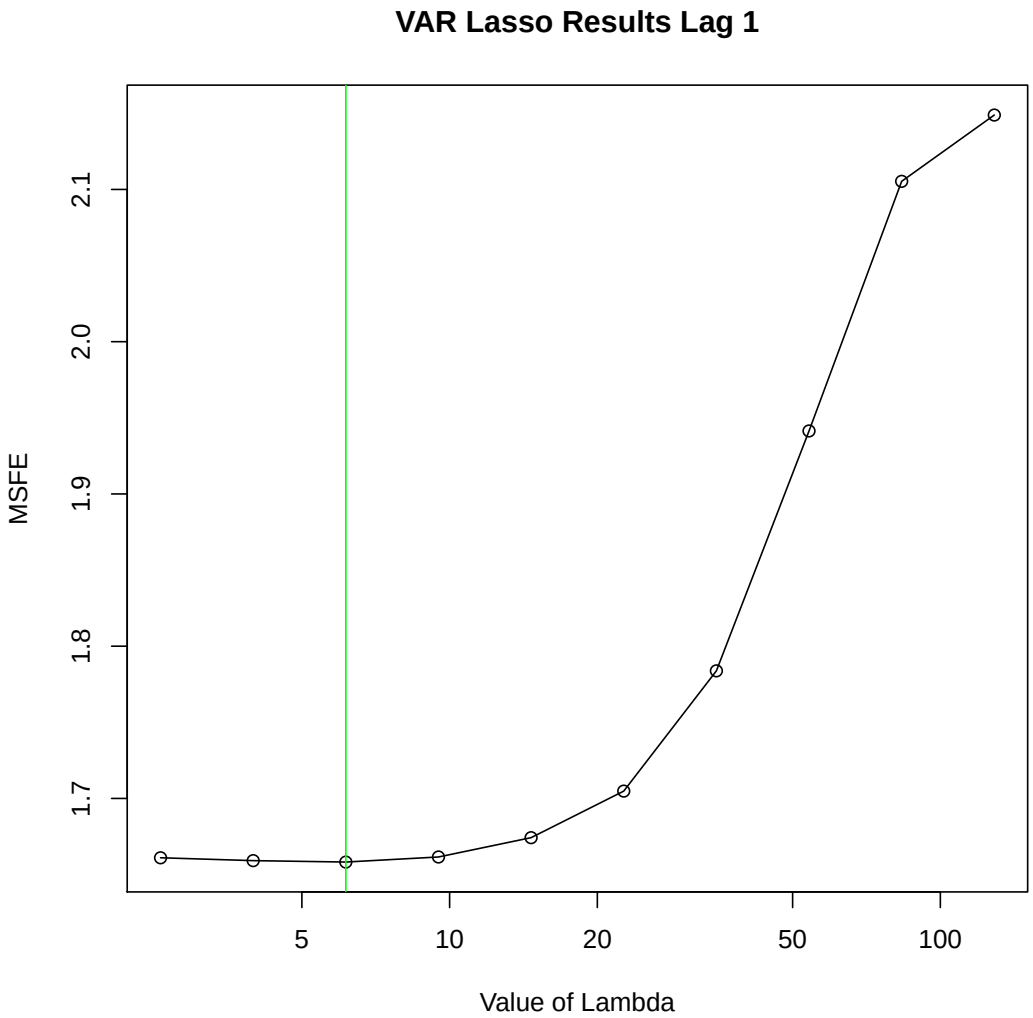


Figure: In-Sample MSE vs. Lambda

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

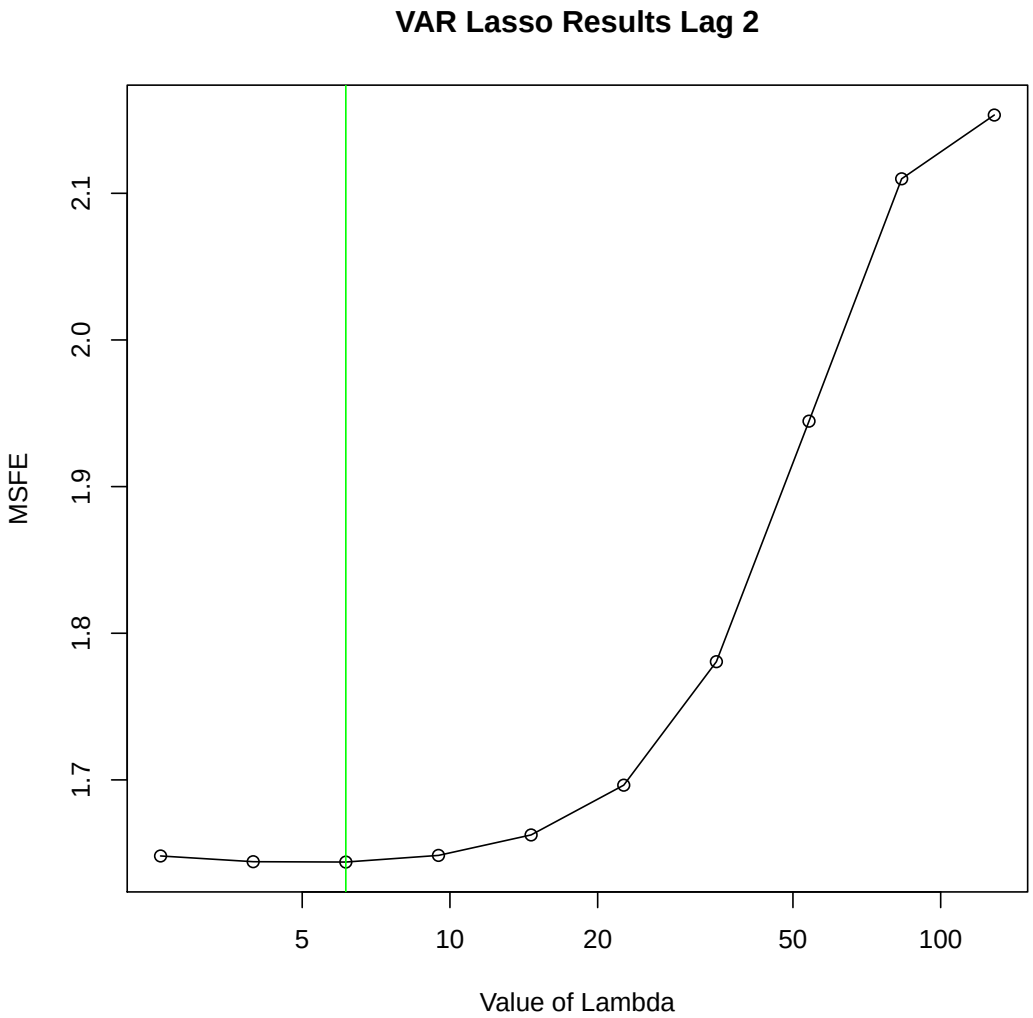


Figure: In-Sample MSE vs. Lambda

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

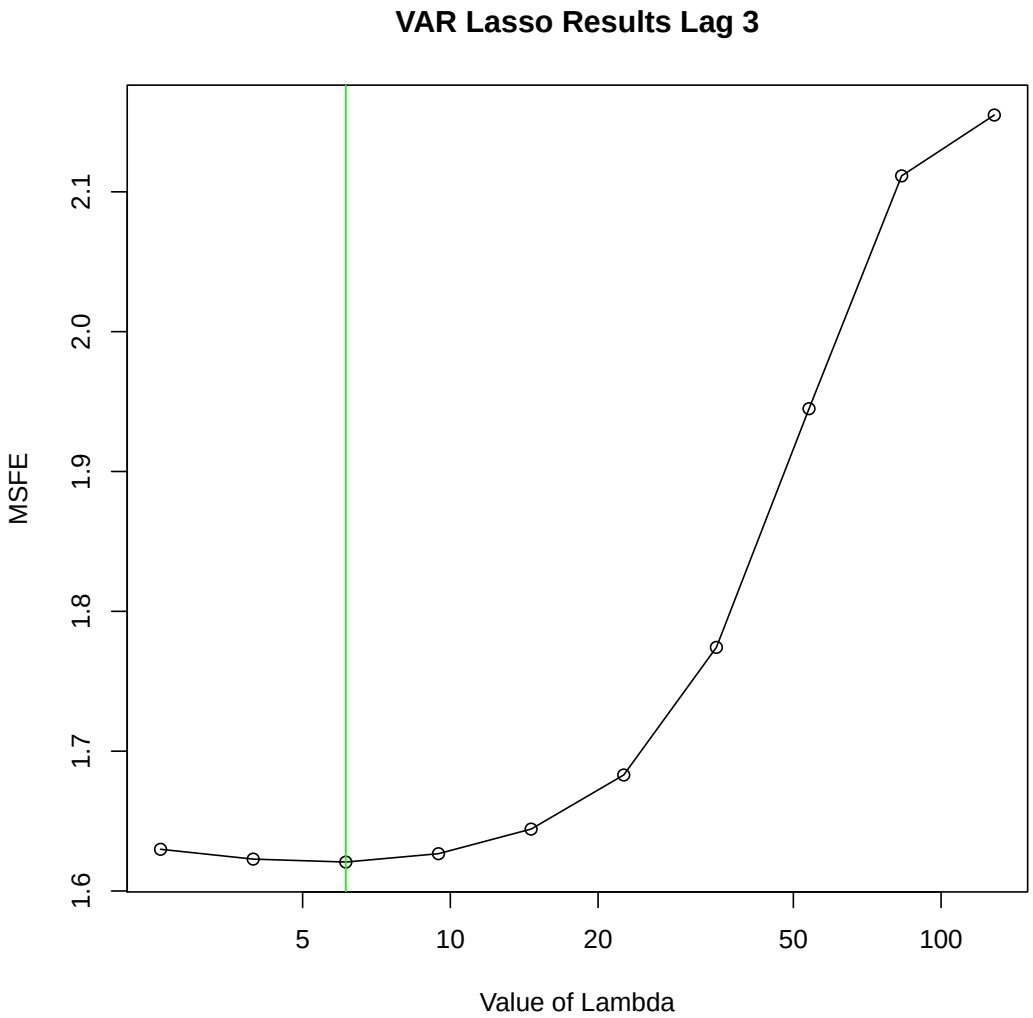


Figure: In-Sample MSE vs. Lambda

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

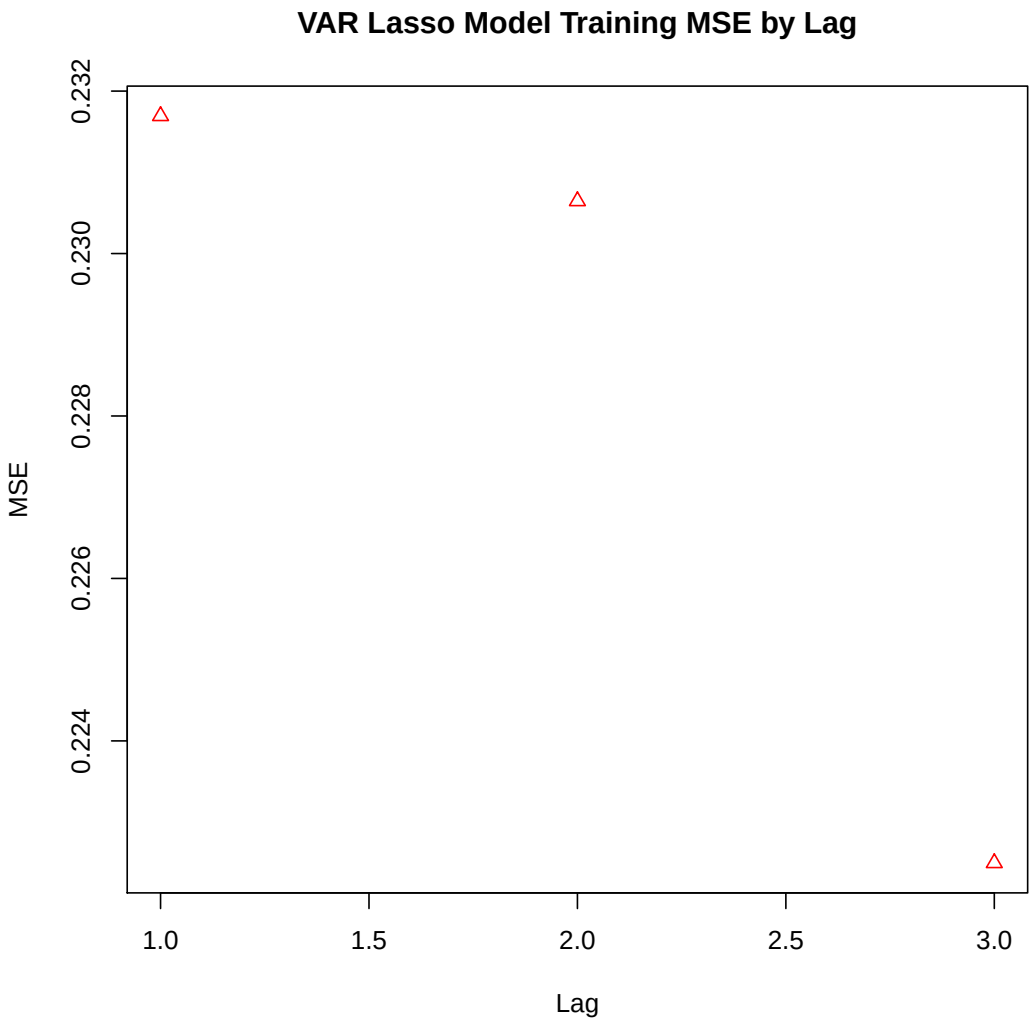


Figure: Test MSE by lag

Results

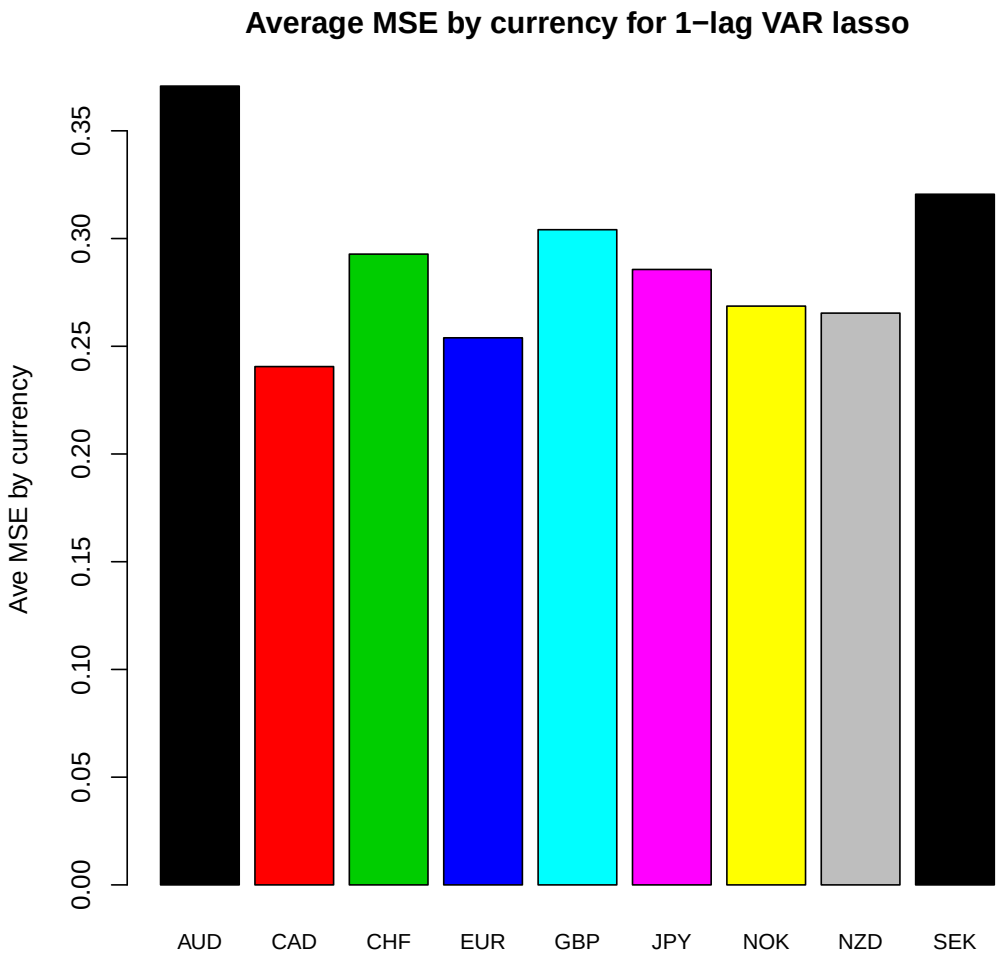


Figure: Test MSE by currency

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

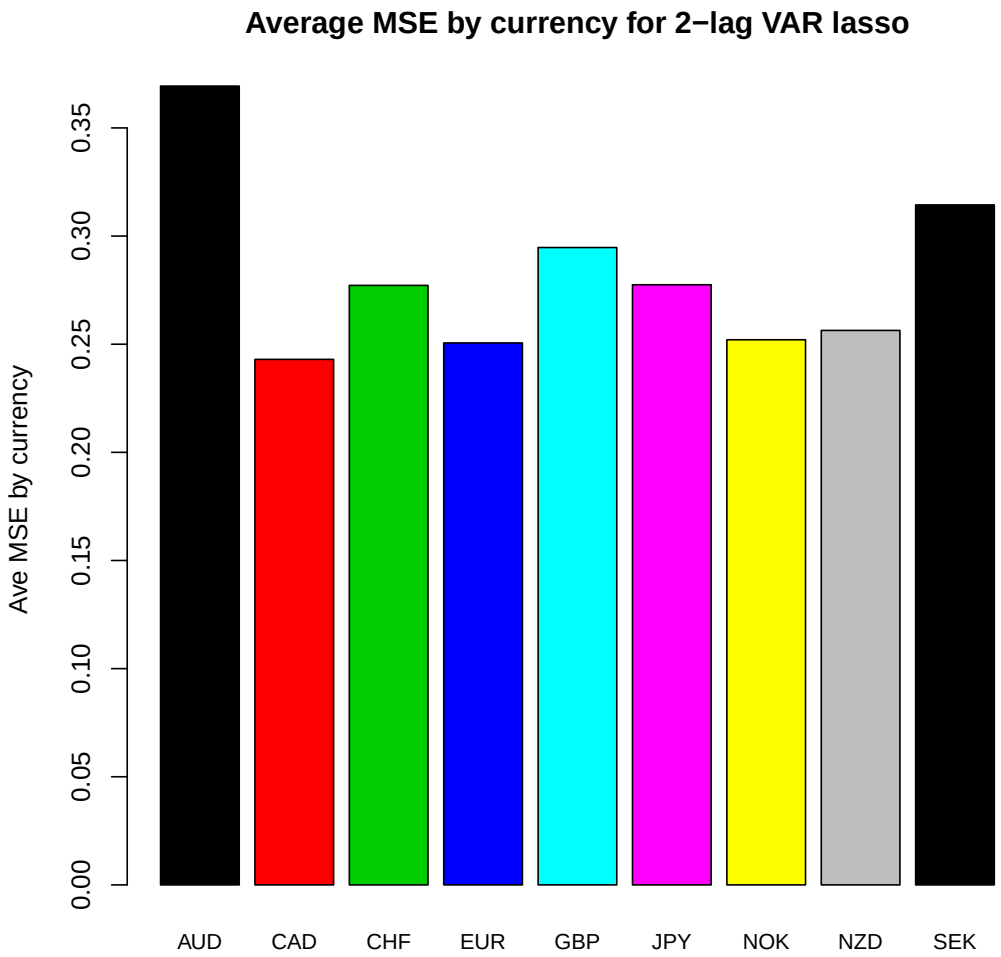


Figure: Test MSE by currency

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

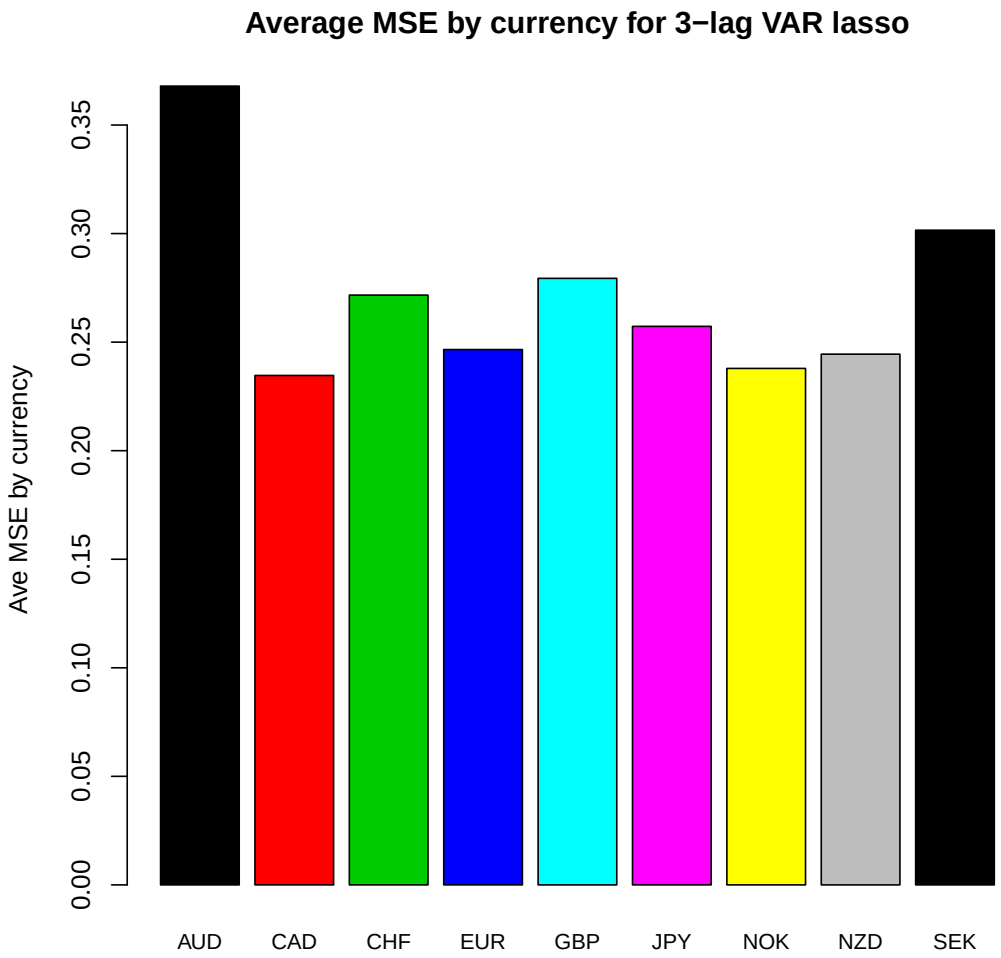


Figure: Test MSE by currency

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Conclusions

- MSEs decrease as a function of lag used

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Conclusions

- MSEs decrease as a function of lag used
- As we are regularizing we are no longer modeling insignificant daily noise that was causing our models to overfit in the previous section

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Conclusions

- MSEs decrease as a function of lag used
- As we are regularizing we are no longer modeling insignificant daily noise that was causing our models to overfit in the previous section
- The success of this model varies by currency with the relative efficacy appearing to be independent of lag used

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Implementation

- Package: orderedLasso

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: orderedLasso
- For each currency fit a lasso to all of train data to obtain the maximum lambda - the lambda which sets all parameters to 0

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: orderedLasso
- For each currency fit a lasso to all of train data to obtain the maximum lambda - the lambda which sets all parameters to 0
- Iterate through lags 2 and 3 - for each lag fit models for each lambda in sequence from 0 to max lambda

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation

- Package: orderedLasso
- For each currency fit a lasso to all of train data to obtain the maximum lambda - the lambda which sets all parameters to 0
- Iterate through lags 2 and 3 - for each lag fit models for each lambda in sequence from 0 to max lambda
- Use model for training and testing errors

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Results

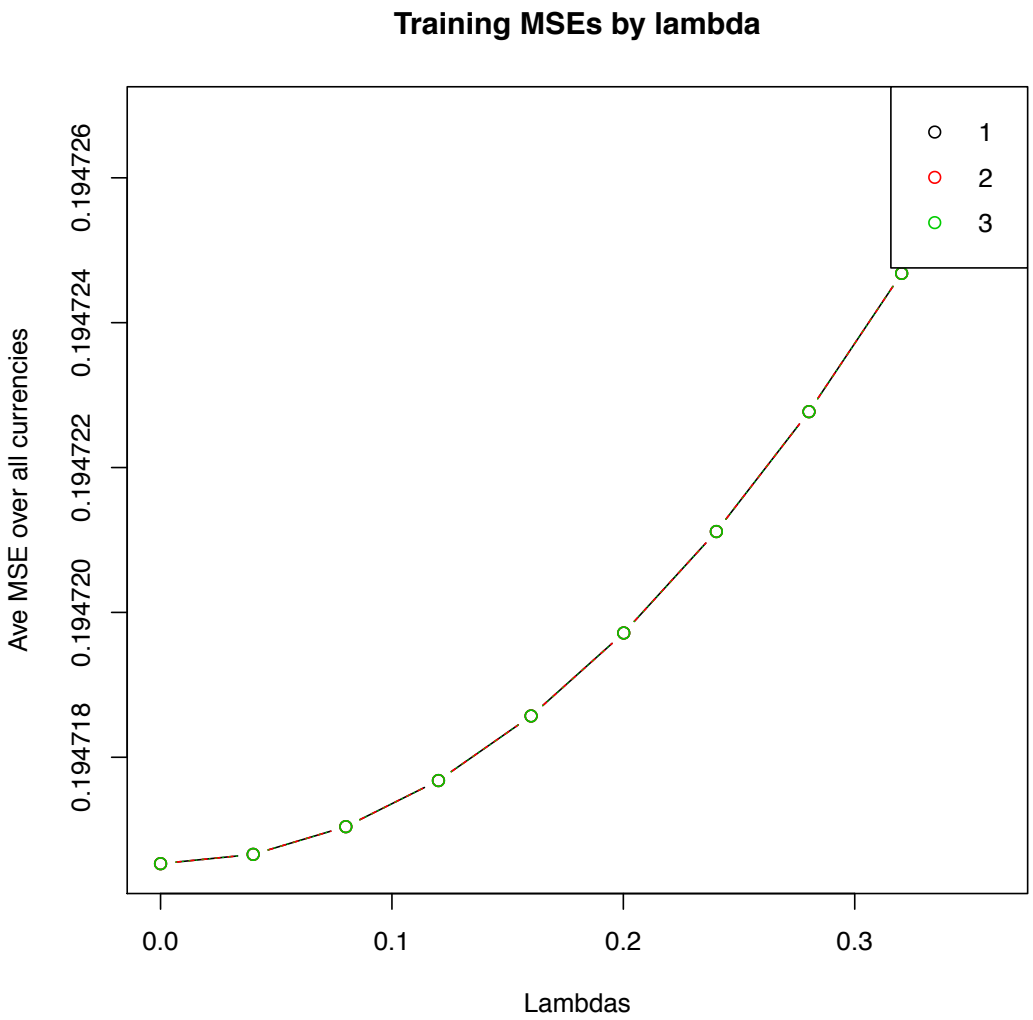


Figure: Training MSEs

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

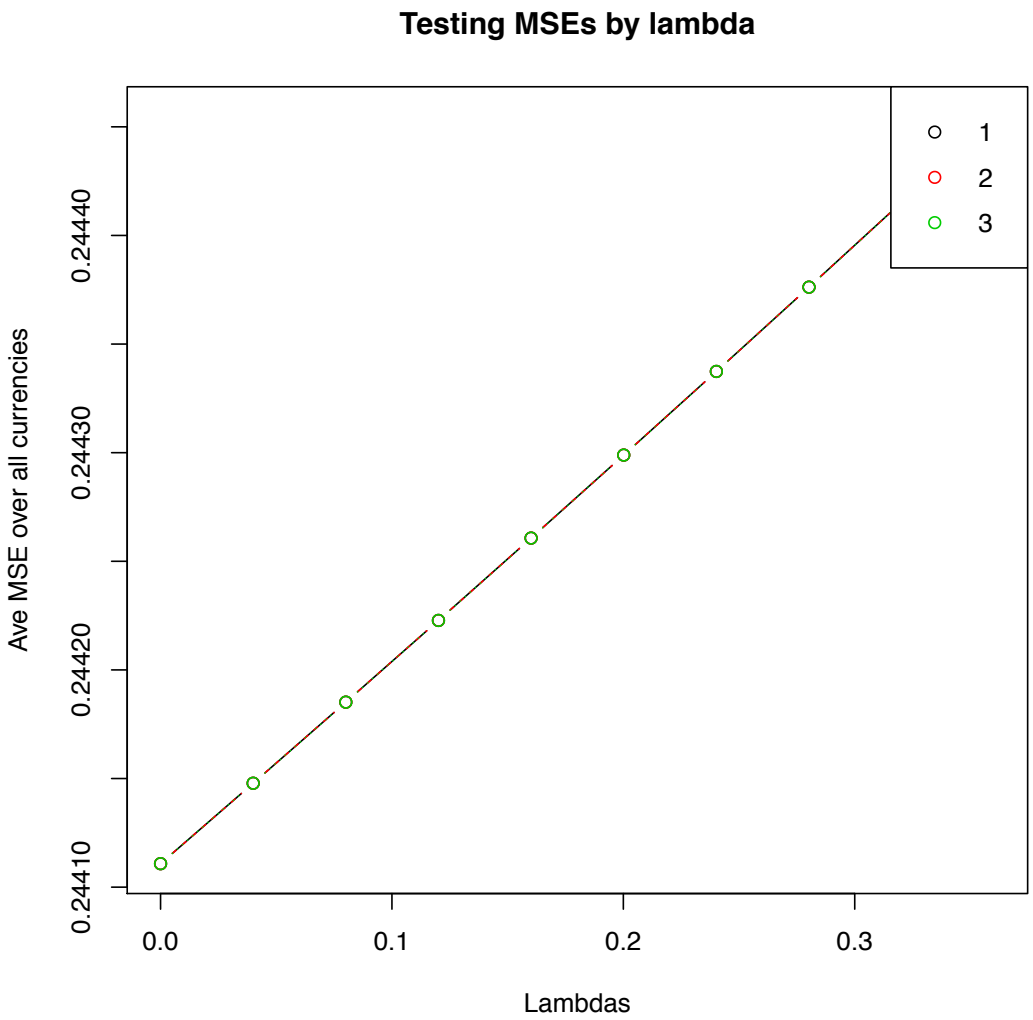


Figure: Testing MSEs

Conclusions

- As expected out-of-sample error is significantly higher than in-sample error

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Conclusions

- As expected out-of-sample error is significantly higher than in-sample error
- MSEs change minimally with lag used

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Conclusions

- As expected out-of-sample error is significantly higher than in-sample error
- MSEs change minimally with lag used
- For ordered lasso, however, regularization does not appear to improve the results

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Implementation of KNN regression

- Iterate through training data by, finding k nearest neighbors in sense of $||\sigma - \sigma_i||^2$

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation of KNN regression

- Iterate through training data by, finding k nearest neighbors in sense of $||\sigma - \sigma_i||^2$
- Create regression matrix of size number observations $\times$ k consisting of the next day volatilities of the k nearest neighbors

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Implementation of KNN regression

- Iterate through training data by, finding k nearest neighbors in sense of $||\sigma - \sigma_i||^2$
- Create regression matrix of size number observations $\times$ k consisting of the next day volatilities of the k nearest neighbors
- Fit regression model on training data using lm package

Implementation of KNN regression

- Iterate through training data by, finding k nearest neighbors in sense of $||\sigma - \sigma_i||^2$
- Create regression matrix of size number observations $\times$ k consisting of the next day volatilities of the k nearest neighbors
- Fit regression model on training data using lm package
- Use regression fit to predict on train, choose k as mse minimizer

Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Adding a time feature

- Modified data to include time stamp

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Adding a time feature

- Modified data to include time stamp
- Find k-Nearest Neighbors where proximity is given by $||\sigma - \sigma_i||_2^2 + c||t - t_i||_2^2$

Adding a time feature

- Modified data to include time stamp
- Find k-Nearest Neighbors where proximity is given by $||\sigma - \sigma_i||_2^2 + c||t - t_i||_2^2$
- Grid search on both k and c to find optimal fit

Introduction

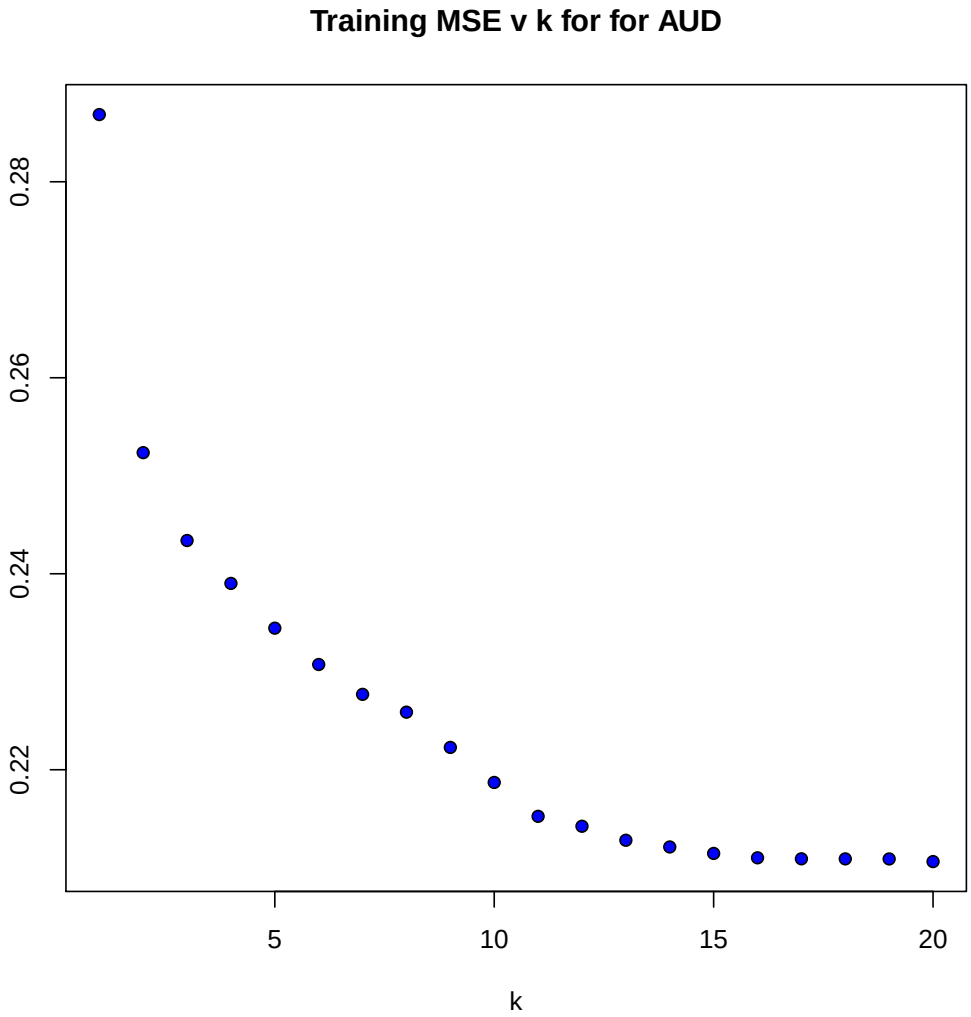
VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

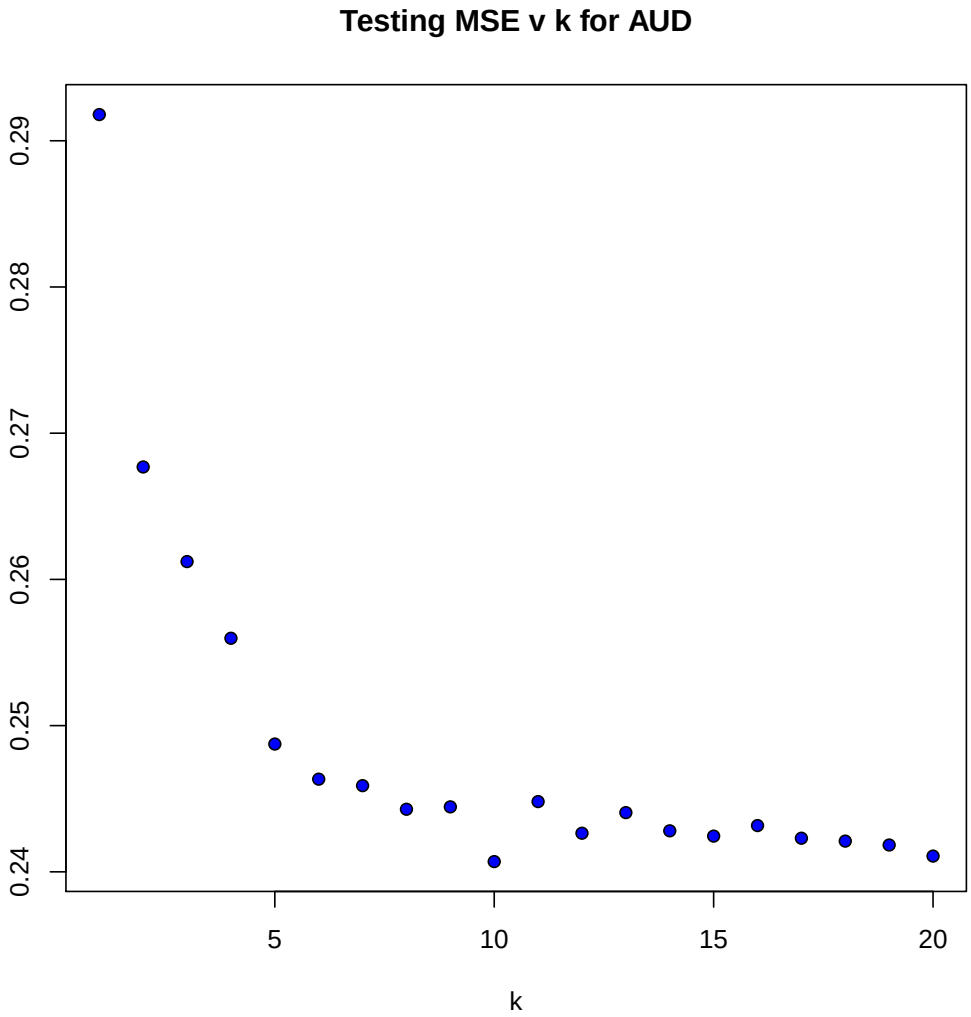
KNN Regression
Implementation
Results
Discussion

Results



Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results



Introduction

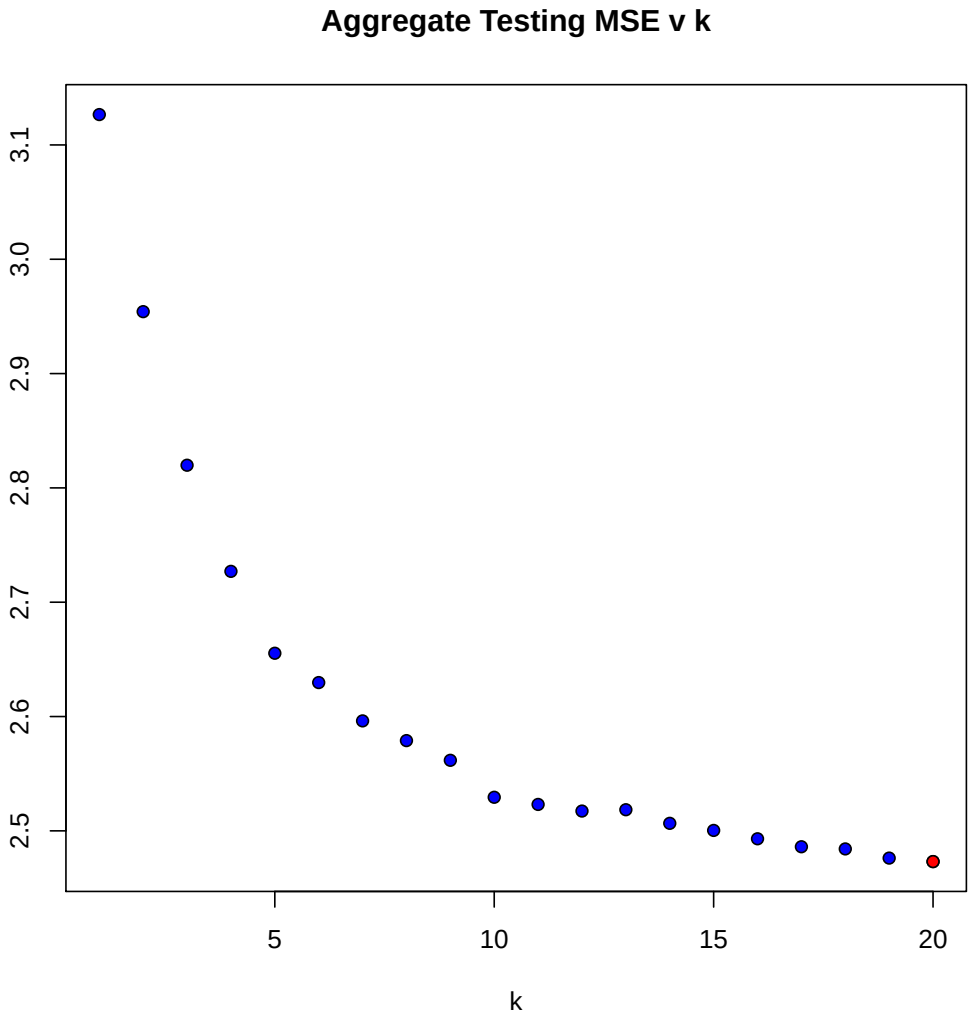
VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Results



Introduction

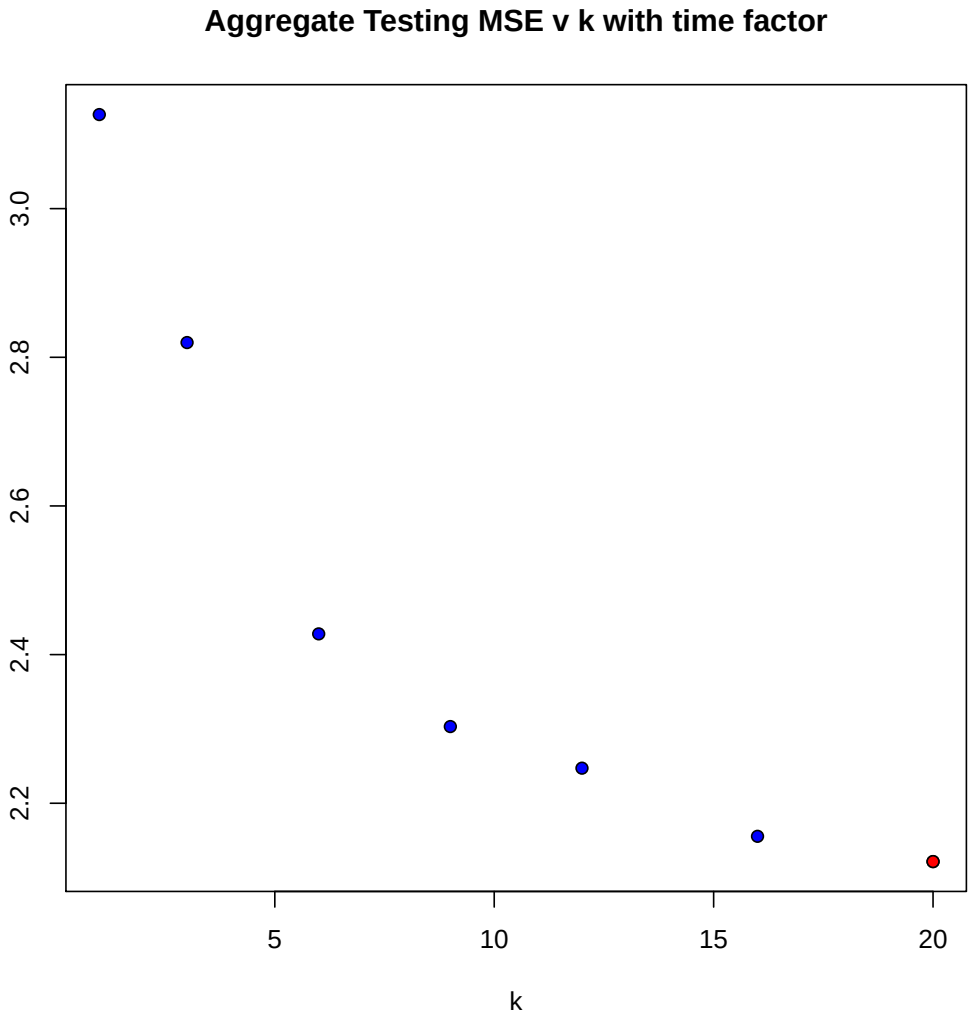
VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

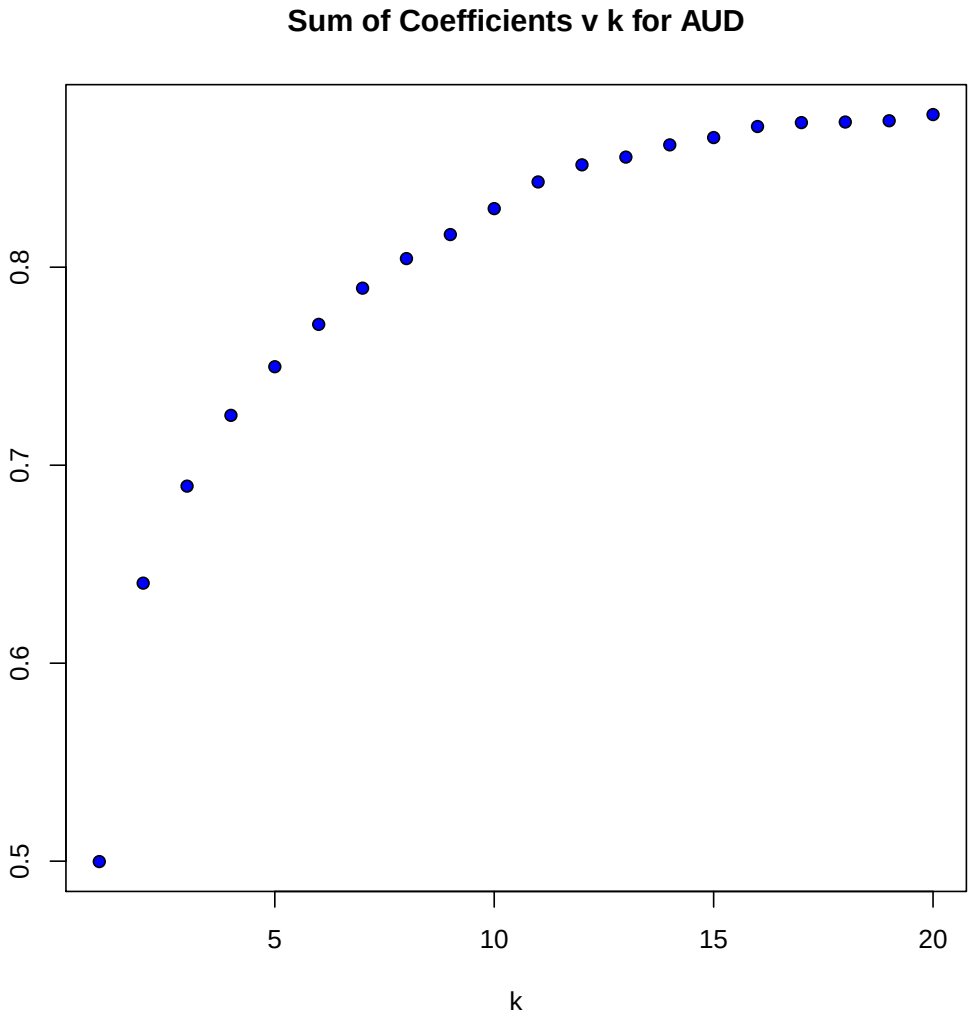
KNN Regression
Implementation
Results
Discussion

Results



Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results



Introduction
VAR
Implementation
Results
Discussion
VAR-Lasso
Implementation
Results
Discussion
Ordered Lasso
Implementation
Results
Discussion
KNN Regression
Implementation
Results
Discussion

Results

	mse	mse_time
AUD	0.240703190493472	0.214044675092349
CAD	0.316645013626961	0.231361961862307
CHF	0.275172816278026	0.237387590343597
EUR	0.241593679178633	0.224679179357182
GBP	0.339759992691741	0.237943342004655
JPY	0.277731656777348	0.244249661672532
NOK	0.273525323365556	0.242030767414946
NZD	0.242115046363221	0.223409448392819
SEK	0.244820645012621	0.244389566411547

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion

Conclusions

- The time effect improves mse
- Regression coefficients do not align with our intuition
- MSEs decrease with k, future work should expand grid for k. Moreover, this result is not robust to changing the look back period.

Introduction

VAR
Implementation
Results
Discussion

VAR-Lasso
Implementation
Results
Discussion

Ordered Lasso
Implementation
Results
Discussion

KNN Regression
Implementation
Results
Discussion