Benchmarking Econometric and Machine Learning Methodologies in Nowcasting US GDP

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April 2023

Introduction

- Many official statistics and SDG indicators, such as GDP, are published with a substantial delay
- Nowcasting can help fill this information gap by creating timely estimates based on data available more quickly
- There are many methodologies in use in the nowcasting literature
- It can be difficult to find an overarching comparison of these methodologies
- It can be even more difficult to figure out how to implement these methodologies for yourself

Methodologies examined

- ARMA (autoregressive moving average time series models)
- BVAR (Bayesian mixed-frequency autoregression)
- DFM (dynamic factor models)
- decision tree
- gradient boosted trees
- LSTM (long short-term memory artificial neural networks)
- MF-VAR (mixed frequency vector autoregression
- MIDAS (mixed data sampling regression)
- MLP (multilayer perceptron/feedforward artificial neural network)
- OLS (ordinary least squares)
- random forest
- Ridge regression

Additional methodologies examined in the rewrite

- DeepVAR
- Elastic net
- Lasso
- Midasml
- XGBoost

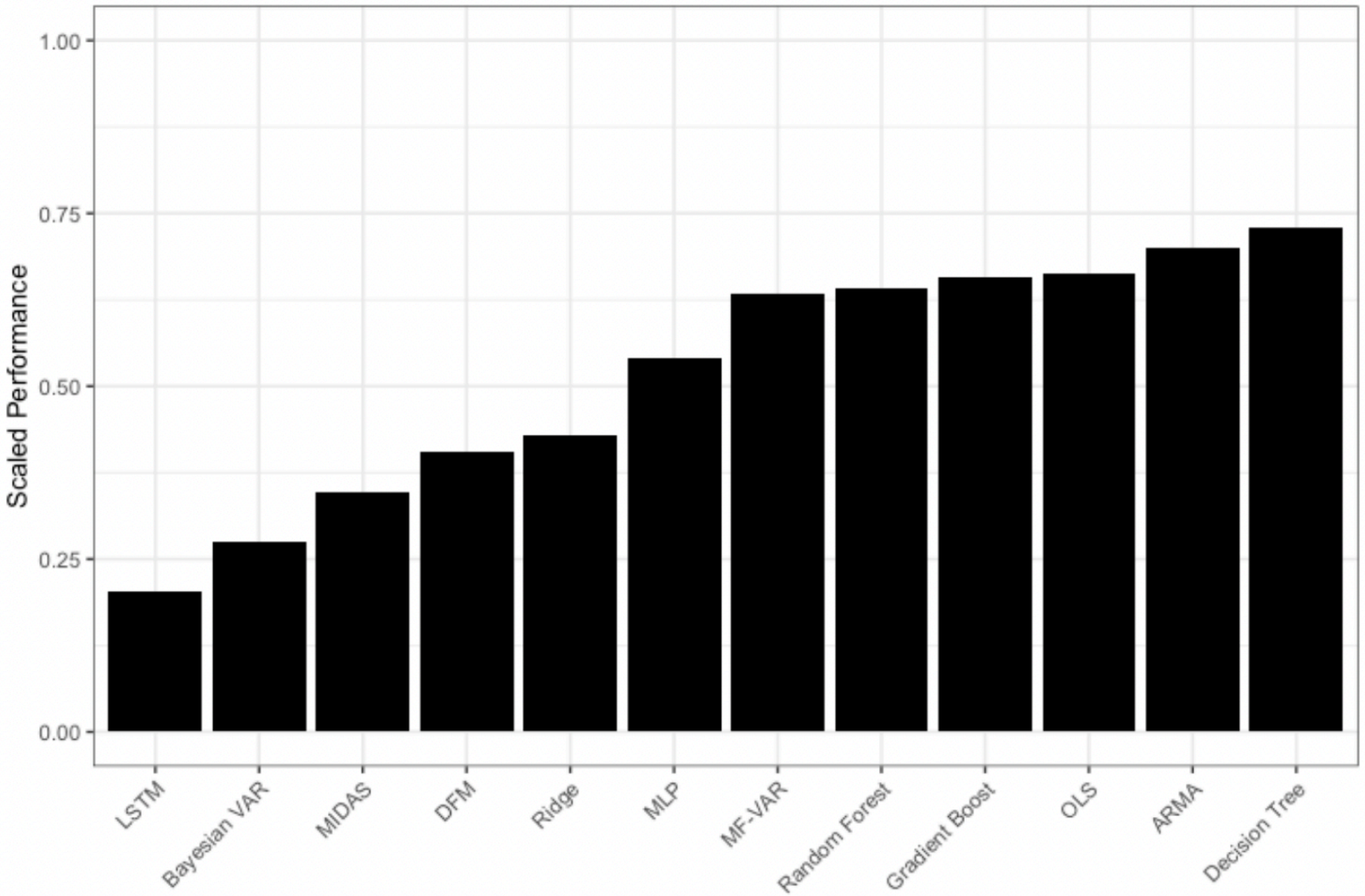
Data

- US GDP, as a commonly nowcasted variable, was chosen as the benchmark target variable
- All data were from the Federal Reserve Economic Data (FRED) API
- Explanatory variables used were those identified in Bok et al. (2018)

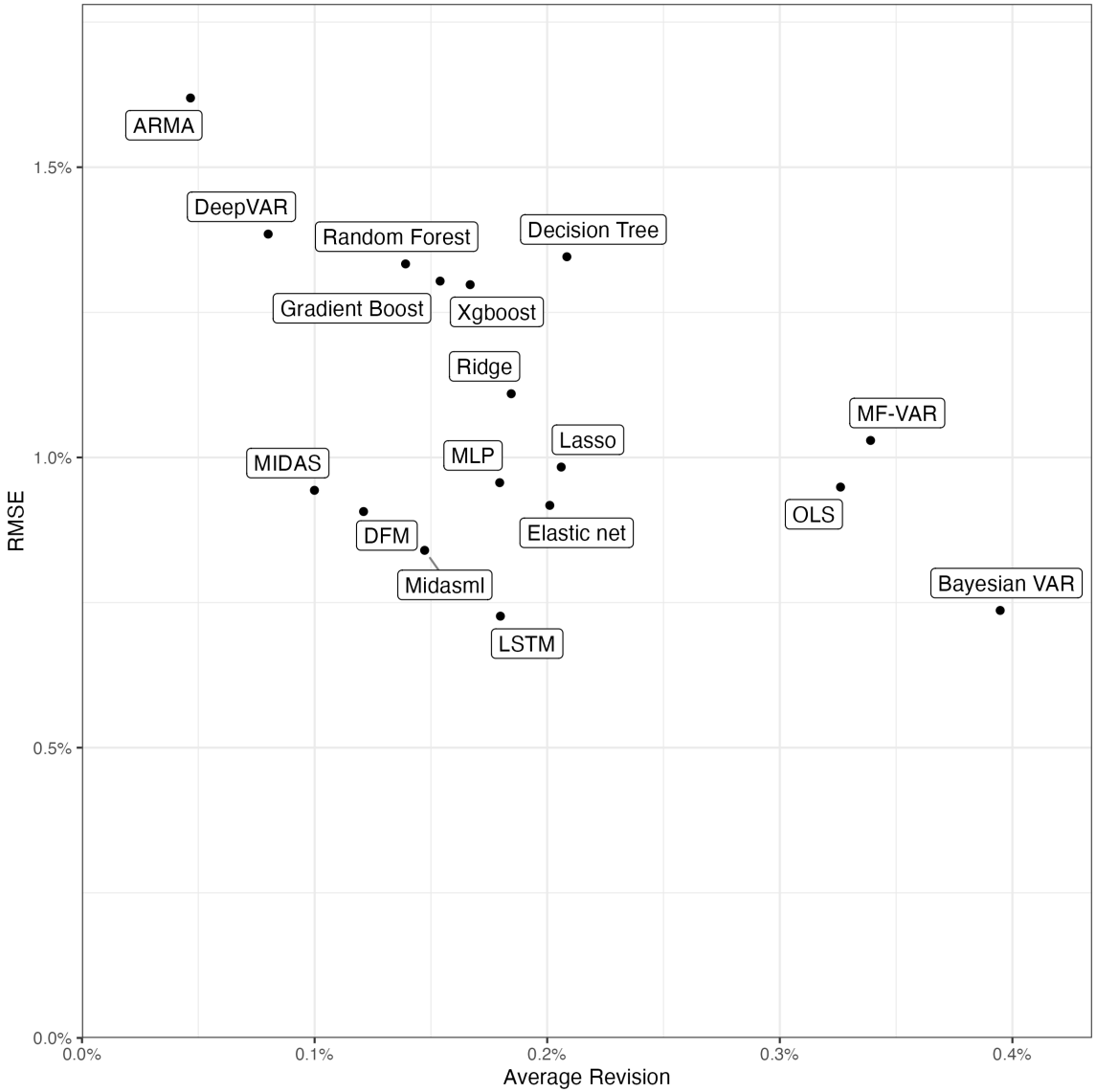
Analysis

- Three separate test periods were assessed, the early 1980s US recession (first quarter of 1972 to the fourth quarter of 1983), the 2008 financial crisis (first quarter of 2005 to the fourth quarter of 2010), and the COVID crisis (first quarter of 2016 to the third quarter of 2021)
- Models were trained with data up until the beginning of the test period and tested on five different artificial vintages

Results


Scaled Performance
1.00
0.75
0.50
0.25
0.00
LSTM
Bayesian VAR
MIDAS
DFM
Ridge
MLP
MF-VAR
Random Forest
Gradient Boost
OLS
ARMA
Decision Tree

Results (cont.)



Results (cont.)

- The two best-performing methodologies in terms of performance were the LSTM and BVAR
- However, the BVAR was much more volatile in its revisions
- More insight to each methodology's characteristics and performance can be found in the full paper and the repository

Conclusion

- The paper and repository provide a comprehensive overview of the performance of most popular nowcasting and machine learning techniques in nowcasting on a benchmark dataset
- More importantly, the boilerplate code to implement any of the methodologies on a new dataset is available on the repository
- The code's availability should enable existing practitioners to try new methodologies, as well as significantly lower the barrier for experimentation for potential new practitioners and applications

Resources

- Full paper
- Benchmark repository
- Original LSTM paper
- UNCTAD nowcasting website
- UNCTAD DFM research paper
- nowcast_lstm library
- For questions please email paper author Daniel Hopp at daniel.hopp@un.org