

Project Proposal: Bayesian Inference for Time Series and State-Space Models

1. Team Identification

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<https://github.com/ANNA-SUN-11/Stat447-team-project.git>

2. Selected Project Theme

- Time Series and State-Space Bayesian Models
- Topic: how does government expenditure affect the Economy growth

3. Literature review summary

- 1) Wu, S.-Y., Tang, J.-H., & Lin, E. S. (2010). The impact of government expenditure on economic growth: How sensitive to the level of development? *Journal of Policy Modeling*, 32(6), 804-817. <https://doi.org/10.1016/j.jpolmod.2010.05.011>
 - This paper finds the positive relationship between government expenditure and economic growth rate. But it only uses the linear regression model.
- 2) Almarashi, A. M., & Khan, K. (2020). Bayesian Structural Time Series. *Nanoscience and Nanotechnology Letters*, 12, 54–61. <https://doi.org/10.1166/nnl.2020.3083>
 - This paper discussed Bayesian Structural Time Series (BSTS) models that provide more accurate long-term forecasting compared to classical ARIMA models when applied to stock price data.
- 3) West, M. (1995). Bayesian time series modeling and analysis. In *Proceedings of the XVth Workshop on Maximum Entropy and Bayesian Methods*. Santa Fe, New Mexico. Retrieved from <http://www.isds.duke.edu>
 - This paper aimed to see if there are significant cyclic or quasi-periodic components in the deep-sea oxygen isotope time series data related to historical climate change by using DLMs and MCMC Methods.

For our topic, how does government expenditure affect the Economy growth? There are some papers that answer it in a linear regression model, but not many solve it by Time Series and State-Space Bayesian Models. We will try the model mentioned in the paper above.

4. Real-World Candidate Dataset

- 1) government expenditure measured by [General government final consumption expenditure \(current US\\$\) | Data](#) from World Bank Open Data and economic growth measured by [GDP growth \(annual %\) | Data](#) from World Bank Open Data.
- 2) Backup data: government expenditure measured by <https://www.imf.org/external/datamapper/exp@FPP/USA/FRA/JPN/GBR/SWE/ESP/ITA/ZAF/IND?year=2023> from international monetary fund and economic growth measured by real GDP growth from https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD?year=2025

5. Approach and Methodology

Aimed to see if the Bayesian Structural Time Series (BSTS) models provide more accurate long-term forecasting compared to classical ARIMA models when applied to the economic growth rate.

1) Data Preprocessing:

- Cleaning and structuring time series data for analysis.
- Handling missing values and potential anomalies.

2) ARIMA (AutoRegressive Integrated Moving Average)

- Determine the best ARIMA parameters (p, d, q) using [Auto-ARIMA](#).
- Fit the model and forecast the economic growth rate.
- Evaluate the performance using [Root Mean Squared Error \(RMSE\)](#).

3) Bayesian Structural Time Series (BSTS)

- Specify model components ([trend, seasonality, regression terms](#)).
- Use [Markov Chain Monte Carlo \(MCMC\)](#) to estimate parameters.
- Perform posterior inference and forecast.

Finally, Comparing the accuracy between ARIMA and BSTS model

6. Plan for teamwork

We will do the literature review, data preprocessing for 2 papers each person; then one person will do the ARIMA model for our topic and write the final paper, and the other one will do

the BSTS model and comparison between two models. For the discussion and conclusion part, we will do it together.