

Harvard Extension Data Science

Dynamic Modeling and Forecasting in Big Data

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Assignment 8

State Space Model and Structural Change

Part A:

- In H08b_structTS.R script, we learned the StructTS function as a simple and efficient way to implement the State Space Model. Now, import the W09c_macro.xlsx (at Data and Script 7) and GDPC1 (real GDP level data) via quantmod library. We use the trainset data from 1990Q1 to 2023Q2. And the testset will be from 2023Q3 to the latest quarter. Our goal is to forecast real GDP level in the testset.
- Similar to Assignment 7, run the Dynamic Factor (3 PCs) Model with 6 lags and the ARIMA (auto.arima) model and compute their RMSEs in the testset.
- Use StructTS function to run the same trainset to forecast GDP in the test period. Try both types: “level” and “trend” and compute their RMSEs. Among these 4 models, show which model is the best and briefly explain it.

Part B:

- In H08a_strucchange.R script, we learned the structure change test and how to detect the breakdates. Following the script and conduct the structure change test for the following equation. The goal is to detect whether α , β_1 , and β_2 are stable over the sample period or not.

$$\text{Job Growth (t)} = \alpha + \beta_1 * \text{Job Growth (t-1)} + \beta_2 * \text{GDP Growth (t)}$$

- Note:
 - Job Growth is `diff(log(PAYEMS))` via FRED in quantmod library and convert it to quarterly frequency.
 - GDP Growth is `diff(log(GDPC1))` via FRED in quantmod library.
 - Combine these variables and make sure the data is balanced (without missing values) from 1948Q1 to 2019Q4.
- First, run the linear regression for the whole sample.
- Second, use breakpoints to detect the break dates. What are these break dates?
- Use three break dates and re-estimate the model (use breakfactor). Briefly explain the results.