

Case Study: Forecasting Inflation and Growth

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Deadline: 17 October 2025, 23:59.

Context and Motivation

Recent headlines emphasize the challenges faced by central banks: inflation remains persistent in the U.S., global supply chain uncertainties continue, and growth forecasts remain fragile amid geopolitical risks. Against this backdrop, the Federal Reserve (Fed) is updating its forecasting system. Benchmark models such as the Factor-Augmented VAR (FA-VAR), the standard VAR, and the Dynamic Factor Model (DFM) remain in use.

The purpose of this case study is for students to produce their own Markdown tutorial (e.g., R Markdown) to advise the Fed.

1 Assignment Instructions

You will create a Markdown tutorial (in R Markdown) that guides the reader step by step through model estimation and forecast comparison. Your document should:

- Introduce the economic context and the Fed's forecasting challenges.
- Present the VAR, FA-VAR, and DFM models, including their state-space representation.
- Estimate and forecast inflation and growth.
- Compare forecast performance using RMSFE and MAE.
- Provide interpretation and policy-relevant insights.

2 Models Under Consideration

2.1 Vector Autoregression (VAR)

A VAR(p) for inflation (π_t) and growth (g_t):

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + u_t, \quad y_t = [\pi_t, g_t]^T. \quad (1)$$

2.2 Factor-Augmented VAR (FA-VAR)

$$X_t = \Lambda F_t + e_t, \quad (2)$$

$$F_t = \Phi_1 F_{t-1} + \dots + \Phi_p F_{t-p} + v_t, \quad (3)$$

$$y_t = B(L)y_{t-1} + C(L)F_t + u_t. \quad (4)$$

2.3 Dynamic Factor Model (DFM)

$$X_t = \Lambda F_t + e_t, \quad e_t \sim \mathcal{N}(0, R), \quad (5)$$

$$F_t = A F_{t-1} + \eta_t, \quad \eta_t \sim \mathcal{N}(0, Q). \quad (6)$$

You are allow to include in any of the above models any covariates you find relevant.

3 Forecast Comparison Metrics

3.1 Root Mean Squared Forecast Error (RMSFE)

$$\text{RMSFE}(h) = \sqrt{\frac{1}{T} \sum_{t=1}^T (y_{t+h} - \hat{y}_{t+h|t})^2}. \quad (7)$$

3.2 Mean Absolute Error (MAE)

$$\text{MAE}(h) = \frac{1}{T} \sum_{t=1}^T |y_{t+h} - \hat{y}_{t+h|t}|. \quad (8)$$

4 Tasks

Each of the following tasks should appear in your Markdown tutorial with code blocks for reproducibility.

Task 0: Models, Estimators, and Comparison Scheme

Task 1: Data Preparation

```
'''{r}
# Load inflation and GDP growth data
# Plot and briefly discuss trends
'''
```

Task 2: Estimate a VAR

```
'''{r}
# Fit a VAR model for inflation and growth
# Choose lag length based on information criteria.
'''
```

Feel free to include covariates and use any dimension reduction or variable selection methods you would like to advocate.

Task 3: Estimate a Factor Augmented VAR (FA-VAR)

```
'''{r}
# Extract latent factors using PCA
# Estimate the FA-VAR using these factors
'''
```

Task 4: Estimate a DFM with Kalman Filter

```
'''{r}
# Specify state-space representation
# Apply the Kalman filter for estimation and forecasting
'''
```

Task 5: Forecasting

```
'''{r}
# Generate h-step-ahead forecasts for inflation and growth for h=1,2,3,...,12.
'''
```

Task 6: Forecast Evaluation

Use RMSFE and MAE:

```
'''{r}
# Compute RMSFE and MAE for each model
# Compare results using relevant test statistics
'''
```

Task 7: Policy Discussion

Write a short interpretation of which method performed best and why this matters for the Fed's decision-making.

Expected Outcome

Students will produce a Markdown (e.g., in R) tutorial that:

- Teaches readers how to estimate VAR, FA-VAR, and DFM models.
- Compares forecasting methods for inflation and growth.
- Provides a reproducible framework linking academic methods to real-world policy challenges.

Indicative Grading Rubric (Total: 100 points)

- Model and Estimators (20 points)
- Implementation and Code (25 points)
- Forecasting Results (20 points)
- Forecasting Evaluation (20 points)
- Clarity and Presentation (15 points)

Relevance

As inflation risks dominate financial news and policymakers debate the risks of recession, reliable forecasts are critical. This assignment connects statistical modeling directly to these policy debates, showing students how their tools are relevant in practice.

5 Data

You can get access through the R package `alfred`.

6 Bonus (+30pts)

Evaluate whether applying a Bayesian approach to each model in the benchmark set improves forecasting performance. Include a Bayesian forecast for each model and discuss the changes in the performance metrics used for comparison.

7 Further remarks and Workshop on Week 5

While your submission is individual, you are allowed to work in a group of 2 or 3. Each group member can submit the same document with the mention of their group's member(s). In Week 5, each group will present part of its work, followed by a discussion prepared by

the second group. As a consequence, **be sure to share your document with the other group before October 17 at 23:59**. The discussion slides must not be longer than five slides, highlighting the strengths and weaknesses of the work discussed. The presentation of the work itself will take the form of a tutorial; hence, it must be produced in Markdown (e.g., R Markdown). You are allowed to use any package. The goal is to show your expertise.