1 Introduction

- Compare MCMC methods with variational methods for forecasting a Dynamic Linear Model and a Stochastic Volatility Model.
- Use a range of different updating methods to adjust forecasts as new data is observed.
- Compare compuation time and forecast accuracy for all approaches.

2 Approaches Considered

MCMC Methods

- Gibbs + Metropolis-Hastings MCMC.
- Hamiltonian Monte Carlo.
- Particle Filtering / QMLE / Extended Kalman Filter / Whatever else is used for SV.

Updating for MCMC

- Full updating - rerun MCMC after each new observation for best possible result.
- No updating - just use multi step ahead forecasts via filtering.

Variational Methods

- Independent Gaussian - Transform parameters to real line eg. $\log(\sigma^2)$.
- Full Rank Gaussian with real line transformation.
- Sampling informed distributions - Copula model from Dißmann's algorithm.
- Neural Network transform of $N(\mathbf{0}, I)$ posterior.
- Stochastic Recurrent Neural Networks - SV Model only.
- Alternative divergence measures eg. Expectation Propogation.

Updating for VB

- Update all parameters and latent variables.
- Update global parameters and latent variables for new data - Hold previous latent variables fixed.
- Do not update, just use filtering and multi step ahead forecasts.

3 Simulation Results

Simulate each estimation/update combination many times, calculate cumulative scores of new observations as well as compuation time for initial fit and each update.

3.1 Dynamic Linear Model

$$y_t = \mu + \beta x_t + \sigma_y \epsilon_t \tag{3.1}$$
$$x_t = \gamma + \phi x_{t-1} + \sigma_x \nu_t \tag{3.2}$$

ϵ_t and $\nu_t \sim Z$

3.2 Stochastic Volatility Model

$$y_t = \exp(\alpha_t/2)\,\epsilon_t \tag{3.3}$$
$$\alpha_t = \gamma + \phi \alpha_{t-1} + \sigma \nu_t \tag{3.4}$$

ϵ_t and $\nu_t \sim Z$. Alternatively transform to another representaiton if that works better for filtering/QMLE etc.

4 Empirical Application

- DLM: Find something
- SV: Intraday stock prices?
- Possibly have a multivariate $\mathbf{y}_t$

5 Discussion