PENN STATE UNIVERSITY
Department of Economics

Econ 597D Sec 001 Computational Economics — Gallant
Project Suggestion 6 — Fall 2015
Due Dec 8, 2015

Fit the model

$$
\begin{aligned}
y_t &= a_0 + a_1(y_{t-1} - a_0) + \exp(v_t)u_{1t} \\
v_t &= b_0 + b_1(v_{t-1} - b_0) + u_{2t} \\
u_{1t} &= \sqrt{1 - r^2}\, e_{1t} + r\, e_{2t} \\
u_{2t} &= s\, e_{2t},
\end{aligned}
$$

where the errors $e_t = (e_{1t}, e_{2t})$ are iid $N_2(0, I)$, to a financial market time series by maximum likelihood using a particle filter to integrate out the hidden Markov process $\{v_t\}$. Note that these equations imply that

$$
\mathrm{Var}(u) = \mathcal{E}(uu') = \begin{pmatrix} 1 & sr \\ sr & s^2 \end{pmatrix}
$$

This is the example used in the EMM distribution at

http://www.aronaldg.org/webfiles/arg/emm.

but with an upper triangular Cholesky factorization of the variance matrix rather than a lower triangular factorization. You could use the time series from that distribution and the sample runs that come with the distribution to get reasonable parameter values to start the maximum likelihood iterations.