PENN STATE UNIVERSITY
Department of Economics

Econ 597D Sec 001 Computational Economics — Gallant
Homework 9 — Fall 2015
Due Nov 10, 2015

Refer to Homework 8. Use the data from that homework, the best `SNP` fit from that homework, and the `EMM` package to fit the stochastic volatility model

$$
\begin{aligned}
y_{1t} &= a_0 + a_1(y_{1,t-1} - a_0) + a_2(y_{2,t-1} - b_0) + \exp(v_t)u_{1t} \\
y_{2t} &= b_0 + b_1(y_{1,t-1} - a_0) + b_2(y_{2,t-1} - b_0) + \exp(v_t)u_{2t} \\
v_t &= c_0 + c_1(v_{t-1} - c_0) + u_{3t} \\
u_{1t} &= z_{1t} \\
u_{2t} &= r_{21}z_{1t} + r_{22}z_{2t} \\
u_{3t} &= r_{31}z_{1t} + r_{32}z_{2t} + r_{33}z_{3t},
\end{aligned}
$$

where the errors $z_t = (z_{1t}, z_{2t}, z_{3t})$ are iid $N_3(0, I)$.

For guidance, review the tutorial section of the slides for the `EMM` lecture and the *EMM User's Guide*. The files `emmusr.h` and `emmusr.cpp` for this homework will be similar to to those for the `svfx` example included with the `EMM` distribution. The main difference is that the dimension of the time series is `M=2` rather than `M=1`. Note, by looking at that code, that the ordering of the equations above, while standard in the literature, is misleading because the last three equations have to be evaluated first, the third one next, and the first two last.

Warning: In the `SNP` parmfile that you use for `EMM`, set `useold=1` in the `TRANSFORM DESCRIPTION` block.

Turn in a plot of your final MCMC chain, the `summary.dat` file, and the `reject.dat` file (or the last of the `reject.dat` files if you run the chain in pieces). My plots for a chain of length 30,000 are Figures 1 through 3 below, which will give you an idea of what you are aiming for.

The way I got my start values for the MCMC chain was to run linear regressions on the first two equations with a_0 and b_0 that center y_1 and y_2 set to the sample means of y_1 and

y_2. For start values I used the sample means for a_0 and b_0 and the a_1, a_2, b_1, and b_2 from the regression. I set $c_0 = 0$ and $c_1 = r_{21} = r_{31} = r_{32} = 0.001$. In my regressions, the residual variance estimate was close to 1 so I set $r_{22} = r_{33} = 1$. In retrospect, I probably should have done some more algebra to get better choices for c_0, r_{22}, r_{33} to compensate for the fact that $\mathcal{E} \exp(v_t) \approx \exp(c_0 + \frac{1}{2} r_{33}^2)$ when $c_1 \approx r_{21} \approx r_{31} \approx r_{32} \approx 0$.

The goal of this homework is for you to get experience using the `EMM` package, not to obtain a high quality fit of this model. Do not spend a lot of time tuning the MCMC chain. Also, you do not have to run an extremely long chain as protection against poor mixing. Run long enough to get past the hill climbing portion of the MCMC chain and then run a chain of length at least 10,000 to plot and turn in. Try to get the rejection rate for each parameter to about 50% if you can, but rejection rates between 20% and 80% for each parameter will be acceptable.

Assuming that you set the lags to 1,610 in your `SNP` fit from Homework 8, I suggest setting the `EMM` simulation length to 6,610. This is too small for serious analysis but is adequate for this assignment. With this setting, you should expect that it will take 25 min. per 5,000 MCMC repetitions on `argux6`. It took me 60,000 MCMC repetitions to burn off transients; i.e., to get past the hill climbing stage. Conclusion: You cannot wait until the last minute to start this homework.

The serial version of `EMM` will be adequate for this homework because you have to burn off transients before you can use the parallel version of `EMM` but by then you are within one run of being finished with this homework. The `R` code that produced my plots is in `ceh09` at the course website; `argux6` has `R` installed.

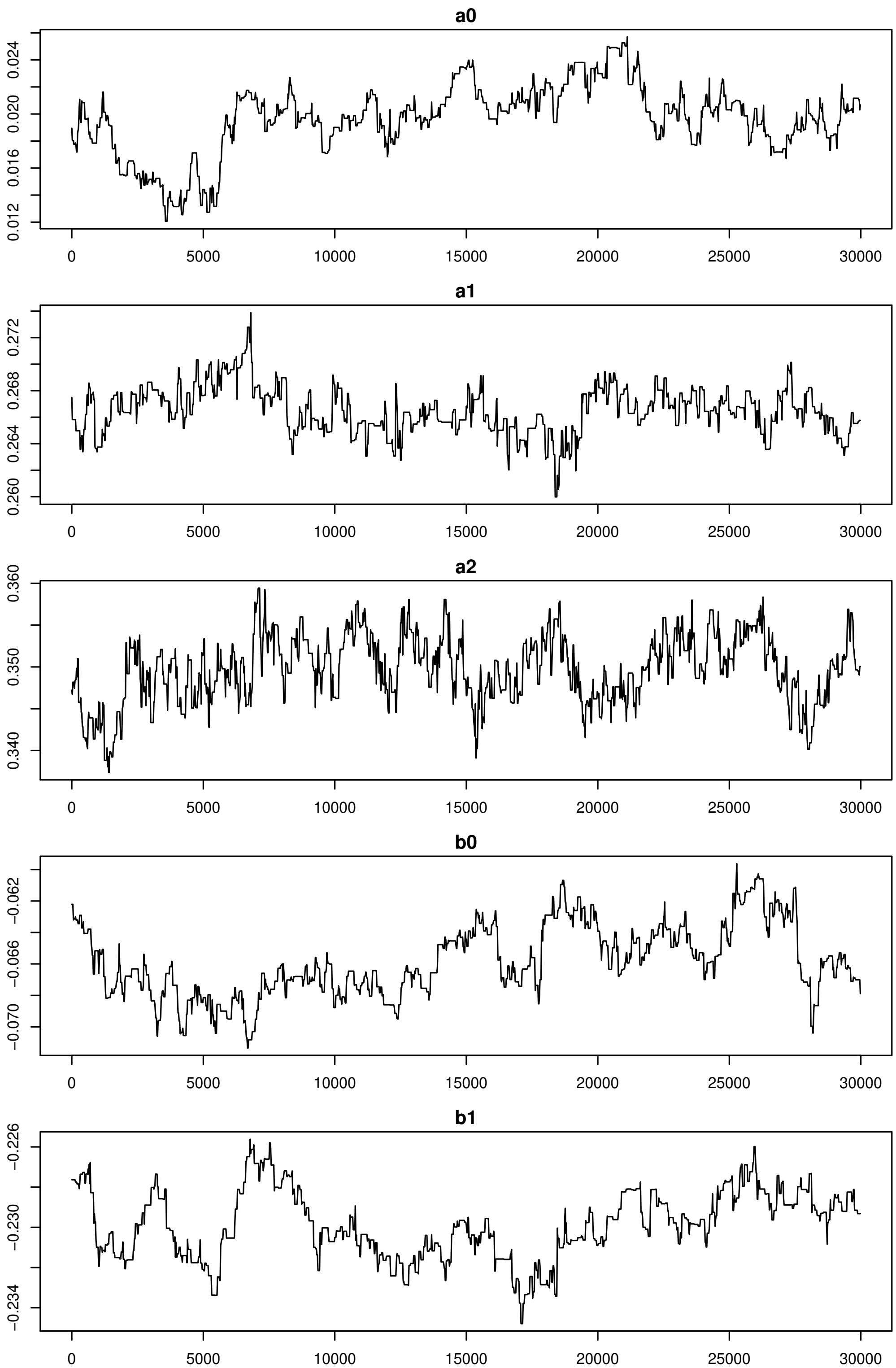

Figure 1. MCMC Chain 1. Shown is every 20th value of the MCMC chain for a stochastic volatility model estimated from the returns on two industry portfolios, NAME_1 and NAME_2.

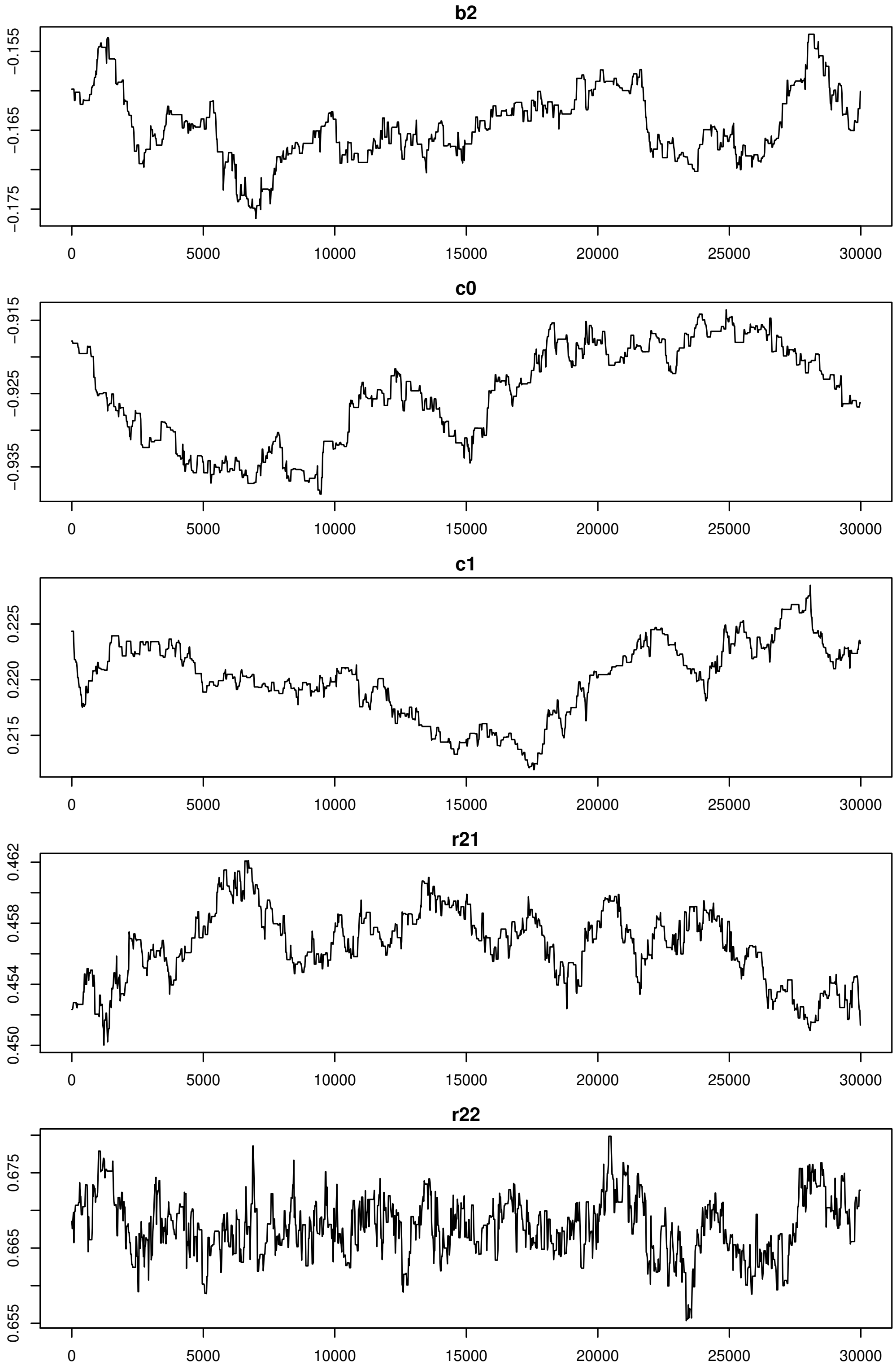

Figure 2. MCMC Chain 2. Shown is every 20th value of the MCMC chain for a stochastic volatility model estimated from the returns on two industry portfolios, NAME_1 and NAME_2.

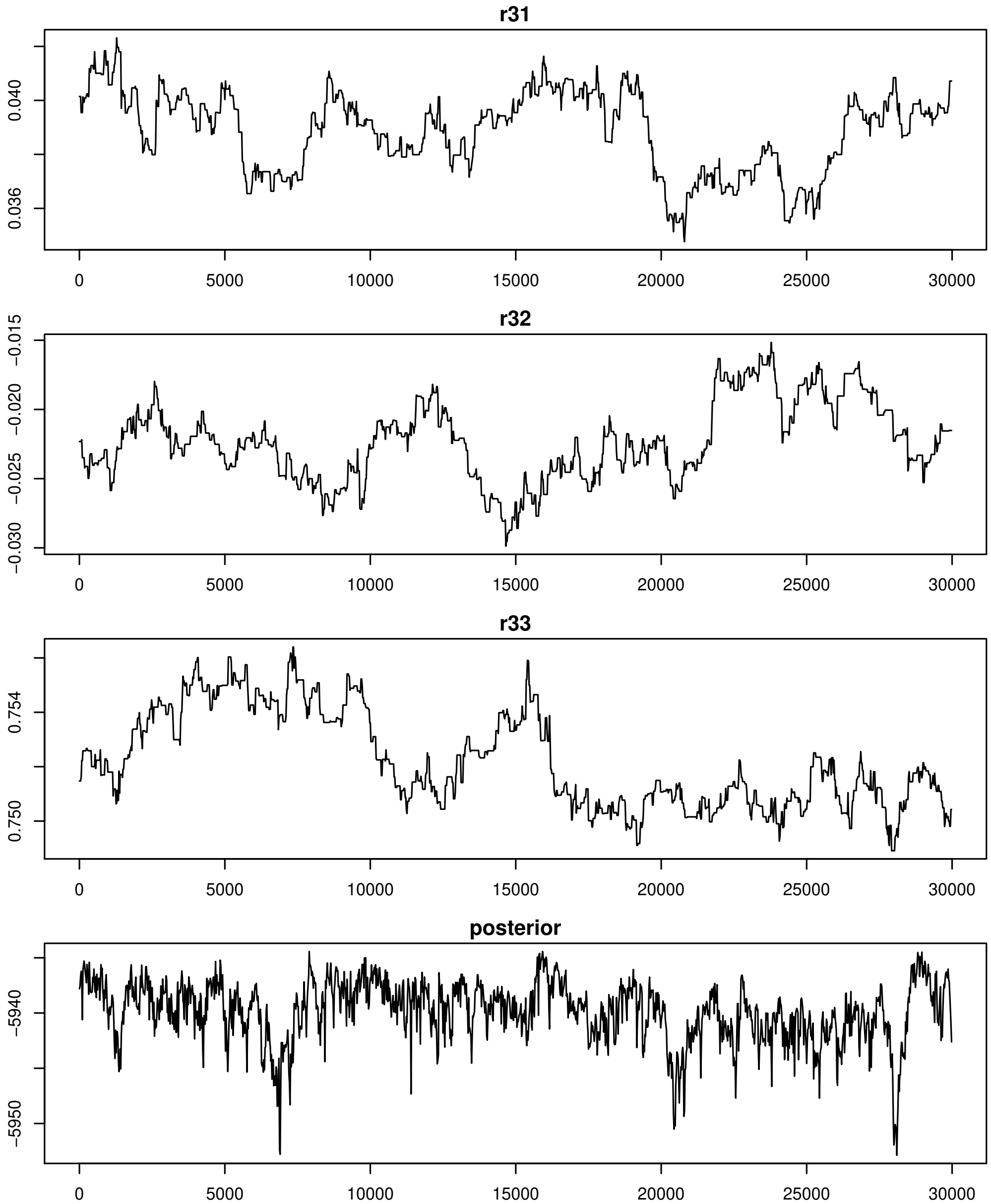

Figure 3. MCMC Chain 3. Shown is every 20th value of the MCMC chain for a stochastic volatility model estimated from the returns on two industry portfolios, NAME_1 and NAME_2.