Solving GENSYS models using AMA

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April 3, 2008

This note goes through the solution of a model cast in GENSYS.m that is put through the Anderson and Moore algorithm using AMAGENSYS.m

1 The General Set-Up in Gensys

Start with a general model which in gensys is cast as

$$G_0 y_t = G_1 y_t + \Psi \epsilon_t + \Pi \eta_t + C \tag{1}$$

with dimensions $y_{[n_y\ 1]}, \epsilon_{[n_x\ 1]}$ and $\eta_{[n_n\ 1]}$ and conformable matrices. C is an $n_y x1$ vector of constants. The solution of the model using gensys is of the form

$$y_t = G y_{t-1} + R\epsilon_t$$

2 The General Set-Up in Anderson and Moore (AMA)

In AMA notation a model would be written as

$$H_{-1} s_{t-1} + H_0 s_t + H_1 s_{t+1} = E\epsilon_t \tag{2}$$

3 Solving a model cast in Gensys using AMA

This is done in the code *amagensys.m*

3.1 Step 1: From Gensys to AMA

Matlab file: *convertfromGensysIn.m*

Expand the state space in eq. (1) to be

$$s(t)_{[(n_y+n_n)x1]} = \begin{pmatrix} y_t \\ \eta_t \end{pmatrix}$$

and rewrite the system in AMA form as

$$\begin{bmatrix} -G_1 & 0 \\ 0 & 0 \end{bmatrix} s_{t-1} + \begin{bmatrix} G_0 & -\Pi \\ 0 & 0 \end{bmatrix} s_t + \begin{bmatrix} 0 & 0 \\ 0 & I_{n_n} \end{bmatrix} s_{t+1} = \begin{bmatrix} E \\ 0 \end{bmatrix} \epsilon_t$$

$$HMs_{t-1} + H0s_t + HPs_{t+1} = \Gamma\epsilon_t \tag{3}$$

The matrices above are respectively called HM,H0 and HP in the code. Note the last line says that conditional on current information

$$n_{t+1} = 0$$

3.2 Step 2: Apply AMA to the new system

Matlab file SPMalg.m

The solution of the homogenous version of eq (3) by the AMA algorithm is

$$s_t = Bs_{t-1}$$

To find the impact effect of the disturbances, note $s_{t+1} = Bs_t$.Pluging this into (3)

$$HMs_{t-1} + [H0 + HP * B]s_t = \Gamma\epsilon_t$$

$$s_t = [H0 + HP * B]^{-1}[\Gamma\epsilon_t - HMs_{t-1}]$$

Let $[H0 + HP * B]^{-1} = \Phi$, and note that B satisfies $B = -(\Phi)HM$. Then the resulting VAR is of the form

$$s_t = \Phi\Gamma\epsilon_t + Bs_{t-1} \tag{4}$$

3.3 Step 3: Write the solution back to Gensys form

Matlab file ConvertoGensysOut.m

Recover the G and R matrices of the Gensys solution.

This is simply extracting the corresponding rows of (4) recalling that $s_t' = [y_t'; \eta_t']$

That is, extract the first n_y rows and columns of B

$$G = B_{.ny,ny}$$

The impact matrix is constructed in the code by first setting up

$$\Gamma_{[n_y+n_n\ nx]} = \begin{bmatrix} E \\ 0 \end{bmatrix}$$

and then extracting the first n_y rows of $\Phi\Gamma$

$$R = \Phi\Gamma_{.ny,nx}$$