GAUSS code for reproducing Empirical Applications in Section 4 of
"Likelihood-Ratio-Based Confidence Sets for the Timing of Structural Breaks"
by Yunjong Eo and James Morley, forthcoming, *Quantitative Economics*.

This version: Feb 9, 2015.[1]

Please contact Yunjong Eo (`yunjong.eo@sydney.edu.au`) if you have any questions about the code.

Note:

This code can be used in conjunction with Qu and Perron's (2007, Econometrica) GAUSS code and we borrow many procedures from their code. It can also be used as stand alone code, requiring only break date estimates from some external source.

(1) Download data files and "invLR.src" in a desired folder.

(2) Put "mbreak.src" from the website for Qu and Perron (2007) in the desired folder. For convenience, we also include the source code in our program zip file.

(3) Run each equation file, modifying as appropriate for different data files, model setup, and estimated break dates. The current setup is for no restrictions on which parameters undergo breaks. Alternatively, commented-out code is provided for restrictions on which parameters undergo breaks.[2]

Also, (i) set 'vauto=1' when applying a correction for heteroskedasticity and/or serial correlation in the errors by Andrews's (1991) method and (ii) set 'prewhit=1'

[1] What we updated from the previous version of codes on Feb 24, 2014 is that we multiply the likelihood difference by two to construct the likelihood ratio statistic following the conventional expression in the manuscript. However, it does not affect the estimated confidence sets in the previous manuscript because the critical value is also doubled accordingly. This adjustment altered two procedures of "cv()" and "invLR_cs()" in "invLR.src".

[2] For purpose of illustration, consider a structural break model for a bivariate regression. For $t \leq \tau$

$$\begin{aligned} y_{1t} &= \beta_1 + \beta_2 x_{1t} + e_{1t} \\ y_{2t} &= \beta_3 + \beta_4 x_{2t} + e_{2t} \end{aligned}$$

and for $t > \tau$

$$\begin{aligned} y_{1t} &= \beta_5 + \beta_6 x_{1t} + e_{1t} \\ y_{2t} &= \beta_7 + \beta_8 x_{2t} + e_{2t}. \end{aligned}$$

In this example, there are two equations ($n = 2$) and three regressors $z_t = (1, x_{1t}, x_{2t})'$ ($q = 3$) . The first and second regressors are used in the first equation and the first and third regressors are

with 'vauto=1' if you want to apply an AR(1) pre-whitening when estimating the robust covariance matrix (see Andrews and Monahan,1992).

(4) Output in the command window is a list of break dates in each confidence set. Also, a graph plotting the confidence sets is generated.

All the models are estimated with GAUSS10.

GAUSS Files:

Equations:

- out_putequation.g : AR(1) model of U.S. Output Growth with one estimated break at observation 144
- consumption_equation.g : AR(2) model of U.S. Consumption Growth with two estimated breaks at observations 44 and 184
- vecm_equation.g : VECM(2) model of U.S. Output-Consumption Growth with four estimated breaks at observations 56, 101, 141, and 194

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used in the second equation. The regressor selection matrix S would be specified as follows:

$$S = \left[\begin{array}{cc|cc} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ \hline 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{array}\right].$$

Note that, if all the regressors are included in each equation, $p = n \times q$ and $S = I_p$.

Now we explain the restriction matrix R. Assume that there are two restrictions $\beta_1 = \beta_5$ and $\beta_4 = \beta_8$. (i.e. eight parameters with two restrictions and R should be an 8×6 matrix.) The restriction matrix R would be specified as follows:

$$R = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 \end{bmatrix}.$$

If we do not have any restrictions, set $R = I_{(cols(S)*(m+1))}$ where m is the number of breaks.

Data:

- ycdata.txt : (log of) U.S. real GDP and consumption of non-durables and services 1947Q1-2012Q1

Source files:

- invLR.src : main procedures for producing 90%, 95%, and 99% confidence sets
- mbreak.src : procedure codes from Qu and Perron (2007)