varstable — Check eigenvalue stability condition

Description

varstable checks the eigenvalue stability condition after estimating the parameters of a vector autoregressive (VAR) model using var, svar, ivsvar, or xtvar.

Quick start

Check eigenvalue stability condition after var, svar, ivsvar, or xtvar

    varstable

Same as above, and graph the eigenvalues of the companion matrix

    varstable, graph

Same as above, and label each eigenvalue with its distance from the unit circle

    varstable, graph dlabel

Same as above, but label the eigenvalues with their moduli

    varstable, graph modlabel

Menu

Statistics > Multivariate time series > VAR diagnostics and tests > Check stability condition of VAR estimates

Syntax

varstable [, *options*]

options	Description
[Main]	
est̲imates(*estname*)	use previously stored results *estname*; default is to use active results
amat(*matrix_name*)	save the companion matrix as *matrix_name*
graph	graph eigenvalues of the companion matrix
dlabel	label eigenvalues with the distance from the unit circle
modlabel	label eigenvalues with the modulus
marker_options	change look of markers (color, size, etc.)
rlopts(*cline_options*)	affect rendition of reference unit circle
nogrid	suppress polar grid circles
pgrid([...])	specify radii and appearance of polar grid circles; see *Options* for details
Add plots	
addplot(*plot*)	add other plots to the generated graph
Y axis, X axis, Titles, Legend, Overall	
twoway_options	any options other than by() documented in [G-3] *twoway_options*

varstable can be used only after var, svar, ivsvar, or xtvar; see [TS] **var**, [TS] **var svar**, [TS] **var ivsvar**, or [XT] **xtvar**.

collect is allowed; see **[U] 11.1.10 Prefix commands**.

Options

$\boxed{\text{Main}}$

estimates(*estname*) requests that varstable use the previously obtained set of var, svar, ivsvar, or xtvar estimates stored as *estname*. By default, varstable uses the active estimation results. See [R] **estimates** for information on manipulating estimation results.

amat(*matrix_name*) specifies a valid Stata matrix name by which the companion matrix **A** can be saved (see *Methods and formulas* for the definition of the matrix **A**). The default is not to save the **A** matrix.

graph causes varstable to draw a graph of the eigenvalues of the companion matrix.

dlabel labels each eigenvalue with its distance from the unit circle. dlabel cannot be specified with modlabel.

modlabel labels the eigenvalues with their moduli. modlabel cannot be specified with dlabel.

marker_options specify the look of markers. This look includes the marker symbol, the marker size, and its color and outline; see [G-3] *marker_options*.

rlopts(*cline_options*) affect the rendition of the reference unit circle; see [G-3] *cline_options*.

nogrid suppresses the polar grid circles.

pgrid([*numlist*] [, *line_options*]) determines the radii and appearance of the polar grid circles. By default, the graph includes nine polar grid circles with radii 0.1, 0.2, ..., 0.9 that have the grid line style. The *numlist* specifies the radii for the polar grid circles. The *line_options* determine the appearance of the polar grid circles; see [G-3] *line_options*. Because the pgrid() option can be repeated, circles with different radii can have distinct appearances.

Add plots

addplot(*plot*) adds specified plots to the generated graph. See [G-3] *addplot_option*.

Y axis, X axis, Titles, Legend, Overall

twoway_options are any of the options documented in [G-3] *twoway_options*, except by(). These include options for titling the graph (see [G-3] *title_options*) and for saving the graph to disk (see [G-3] *saving_option*).

Remarks and examples

Inference after var and svar and ivsvar and xtvar requires that variables be covariance stationary. The variables in $\mathbf{y}_t$ are covariance stationary if their first two moments exist and are independent of time. More explicitly, a variable y_t is covariance stationary if

1. $E[y_t]$ is finite and independent of t.
2. $\mathrm{Var}[y_t]$ is finite and independent of t
3. $\mathrm{Cov}[y_t, y_s]$ is a finite function of $|t - s|$ but not of t or s alone.

Interpretation of VAR models, however, requires that an even stricter stability condition be met. If a VAR model is stable, it is invertible and has an infinite-order vector moving-average representation. If the VAR model is stable, impulse–response functions and forecast-error variance decompositions have known interpretations.

Lütkepohl (2005) and Hamilton (1994) both show that if the modulus of each eigenvalue of the matrix **A** is strictly less than one, the fitted VAR model is stable (see *Methods and formulas* for the definition of the matrix **A**).

▷ Example 1

After fitting a VAR model, we can use varstable to check the stability condition. Using the same VAR model that was used in [TS] **var**, we demonstrate the use of varstable.

```
. use https://www.stata-press.com/data/r19/lutkepohl2
(Quarterly SA West German macro data, Bil DM, from Lutkepohl 1993 Table E.1)
. var dln_inv dln_inc dln_consump if qtr>=tq(1961q2) & qtr<=tq(1978q4)
(output omitted)
. varstable, graph

  Eigenvalue stability condition
```

Eigenvalue		Modulus
.5456253		.545625
-.3785754 +	.3853982*i*	.540232
-.3785754 -	.3853982*i*	.540232
-.0643276 +	.4595944*i*	.464074
-.0643276 -	.4595944*i*	.464074
-.3698058		.369806

```
  All the eigenvalues lie inside the unit circle.
  VAR satisfies stability condition.
```

Because the modulus of each eigenvalue is strictly less than 1, the estimates satisfy the eigenvalue stability condition.

Specifying the graph option produced a graph of the eigenvalues with the real components on the x axis and the complex components on the y axis. The graph below indicates visually that these eigenvalues are well inside the unit circle.

Roots of the companion matrix

◁
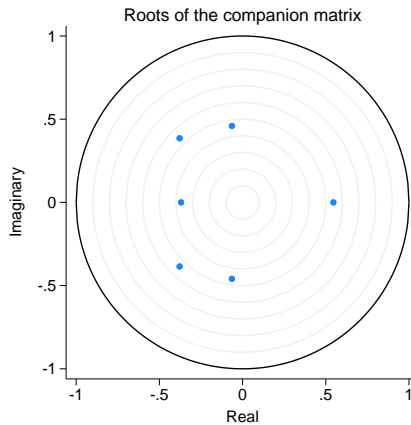
▷ Example 2

This example illustrates two other features of the varstable command. First, varstable can check the stability of the estimates of the VAR model underlying an SVAR model fit by svar or ivsvar. Second, varstable can check the stability of any previously stored var, svar, ivsvar, or xtvar estimates.

We begin by refitting the previous VAR model and storing the results as var1. Because this is the same VAR model that was fit in the previous example, the stability results should be identical.

```
. var dln_inv dln_inc dln_consump if qtr>=tq(1961q2) & qtr<=tq(1978q4)
(output omitted)
. estimates store var1
```

Now we use svar to fit an SVAR model with a different underlying VAR model and check the estimates of that underlying VAR model for stability.

```
. matrix A = (.,0\.,.)
. matrix B = I(2)
. svar d.ln_inc d.ln_consump, aeq(A) beq(B)
(output omitted)
. varstable
```

Eigenvalue stability condition

Eigenvalue		Modulus
.548711		.548711
-.2979493 +	.4328013i	.525443
-.2979493 -	.4328013i	.525443
-.3570825		.357082

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

The estimates() option allows us to check the stability of the var results stored as var1.

```
. varstable, est(var1)

  Eigenvalue stability condition
```

Eigenvalue	Modulus
.5456253	.545625
-.3785754 + .3853982i	.540232
-.3785754 - .3853982i	.540232
-.0643276 + .4595944i	.464074
-.0643276 - .4595944i	.464074
-.3698058	.369806

```
  All the eigenvalues lie inside the unit circle.
  VAR satisfies stability condition.
```

The results are identical to those obtained in the previous example, confirming that we were checking the results in var1.

◁

Stored results

varstable stores the following in r():

Matrices
    r(Re)   real part of the eigenvalues of A
    r(Im)   imaginary part of the eigenvalues of A
    r(Modulus)   modulus of the eigenvalues of A

Methods and formulas

varstable forms the companion matrix

$$
\mathbf{A} = \begin{pmatrix} \mathbf{A}_1 & \mathbf{A}_2 & \cdots & \mathbf{A}_{p-1} & \mathbf{A}_p \\ \mathbf{I} & \mathbf{0} & \cdots & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{I} & \cdots & \mathbf{0} & \mathbf{0} \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ \mathbf{0} & \mathbf{0} & \cdots & \mathbf{I} & \mathbf{0} \end{pmatrix}
$$

and obtains its eigenvalues by using matrix eigenvalues. The modulus of the complex eigenvalue $r + ci$ is $\sqrt{r^2 + c^2}$. As shown by Lütkepohl (2005) and Hamilton (1994), the VAR model is stable if the modulus of each eigenvalue of $\mathbf{A}$ is strictly less than 1.

References

Hamilton, J. D. 1994. *Time Series Analysis.* Princeton, NJ: Princeton University Press. https://doi.org/10.2307/j. ctv14jx6sm.

Lütkepohl, H. 1993. *Introduction to Multiple Time Series Analysis.* 2nd ed. New York: Springer.

———. 2005. *New Introduction to Multiple Time Series Analysis.* New York: Springer.

Also see

For suggested citations, see the FAQ on citing Stata documentation.