Title

> **vargranger —** Pairwise Granger causality tests

Description	Quick start	Menu	Syntax
Options	Remarks and examples	Stored results	Methods and formulas
References	Also see		

Description

vargranger performs a set of Granger causality tests for each equation in a vector autoregressive (VAR) model, providing a convenient alternative to test; see [R] **test**.

Quick start

Perform a Granger causality test after var, svar, ivsvar, or xtvar

    vargranger

Perform a Granger causality test on vector autoregression estimation results stored as myest

    vargranger, estimates(myest)

Menu

Statistics > Multivariate time series > VAR diagnostics and tests > Granger causality tests

Syntax

> vargranger [, <u>est</u>imates(*estname*) <u>separator</u>(#)]

vargranger 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

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

separator(#) specifies how often separator lines should be drawn between rows. By default, separator lines appear every K lines, where K is the number of equations in the VAR model under analysis. For example, separator(1) would draw a line between each row, separator(2) between every other row, and so on. separator(0) specifies that lines not appear in the table.

Remarks and examples   [stata.com]

After fitting a VAR model, we may want to know whether one variable "Granger-causes" another (Granger 1969). A variable x is said to Granger-cause a variable y if, given the past values of y, past values of x are useful for predicting y. A common method for testing Granger causality is to regress y on its own lagged values and on lagged values of x and test the null hypothesis that the estimated coefficients on the lagged values of x are jointly zero. Failure to reject the null hypothesis is equivalent to failing to reject the hypothesis that x does not Granger-cause y.

For each equation and each endogenous variable that is not the dependent variable in that equation, vargranger computes and reports Wald tests that the coefficients on all the lags of an endogenous variable are jointly zero. For each equation in a VAR model, vargranger tests the hypotheses that each of the other endogenous variables does not Granger-cause the dependent variable in that equation.

Because it may be interesting to investigate these types of hypotheses by using the VAR model that underlies an SVAR model, vargranger can also produce these tests by using the e() results from svar or ivsvar. When vargranger uses svar or ivsvar e() results, the hypotheses concern the underlying var estimates.

See [TS] **var**, [TS] **var svar**, [TS] **var ivsvar**, and [XT] **xtvar** for information about fitting VAR models, SVAR models, and panel-data VAR models in Stata. See Lütkepohl (2005), Hamilton (1994), and Amisano and Giannini (1997) for information about Granger causality and on VAR models and SVAR models in general.

▷ Example 1: After var

Here we refit the model with German data described in [TS] **var** and then perform Granger causality tests with `vargranger`.

```
. use https://www.stata-press.com/data/r18/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(1978q4), dfk small
 (output omitted )
. vargranger
```

Granger causality Wald tests

Equation	Excluded	F	df	df_r	Prob > F
dln_inv	dln_inc	.04847	2	66	0.9527
dln_inv	dln_consump	1.5004	2	66	0.2306
dln_inv	ALL	1.5917	4	66	0.1869
dln_inc	dln_inv	1.7683	2	66	0.1786
dln_inc	dln_consump	1.7184	2	66	0.1873
dln_inc	ALL	1.9466	4	66	0.1130
dln_consump	dln_inv	.97147	2	66	0.3839
dln_consump	dln_inc	6.1465	2	66	0.0036
dln_consump	ALL	3.7746	4	66	0.0080

Because the `estimates()` option was not specified, `vargranger` used the active `e()` results. Consider the results of the three tests for the first equation. The first is a Wald test that the coefficients on the two lags of `dln_inc` that appear in the equation for `dln_inv` are jointly zero. The null hypothesis that `dln_inc` does not Granger-cause `dln_inv` cannot be rejected. Similarly, we cannot reject the null hypothesis that the coefficients on the two lags of `dln_consump` in the equation for `dln_inv` are jointly zero, so we cannot reject the hypothesis that `dln_consump` does not Granger-cause `dln_inv`. The third test is with respect to the null hypothesis that the coefficients on the two lags of all the other endogenous variables are jointly zero. Because this cannot be rejected, we cannot reject the null hypothesis that `dln_inc` and `dln_consump`, jointly, do not Granger-cause `dln_inv`.

Because we failed to reject most of these null hypotheses, we might be interested in imposing some constraints on the coefficients. See [TS] **var** for more on fitting VAR models with constraints on the coefficients.

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▷ Example 2: Using test instead of vargranger

We could have used `test` to compute these Wald tests, but `vargranger` saves a great deal of typing. Still, seeing how to use `test` to obtain the results reported by `vargranger` is useful.

```
. test [dln_inv]L.dln_inc [dln_inv]L2.dln_inc

 ( 1)  [dln_inv]L.dln_inc = 0
 ( 2)  [dln_inv]L2.dln_inc = 0

       F(  2,    66) =     0.05
            Prob > F =    0.9527
. test [dln_inv]L.dln_consump [dln_inv]L2.dln_consump, accumulate

 ( 1)  [dln_inv]L.dln_inc = 0
 ( 2)  [dln_inv]L2.dln_inc = 0
 ( 3)  [dln_inv]L.dln_consump = 0
 ( 4)  [dln_inv]L2.dln_consump = 0

       F(  4,    66) =     1.59
            Prob > F =    0.1869
. test [dln_inv]L.dln_inv [dln_inv]L2.dln_inv, accumulate

 ( 1)  [dln_inv]L.dln_inc = 0
 ( 2)  [dln_inv]L2.dln_inc = 0
 ( 3)  [dln_inv]L.dln_consump = 0
 ( 4)  [dln_inv]L2.dln_consump = 0
 ( 5)  [dln_inv]L.dln_inv = 0
 ( 6)  [dln_inv]L2.dln_inv = 0

       F(  6,    66) =     1.62
            Prob > F =    0.1547
```

The first two calls to `test` show how `vargranger` obtains its results. The first test reproduces the first test reported for the `dln_inv` equation. The second test reproduces the ALL entry for the first equation. The third test reproduces the standard F statistic for the `dln_inv` equation, reported in the header of the `var` output in the previous example. The standard F statistic also includes the lags of the dependent variable, as well as any exogenous variables in the equation. This illustrates that the test performed by `vargranger` of the null hypothesis that the coefficients on all the lags of all the other endogenous variables are jointly zero for a particular equation; that is, the All test is not the same as the standard F statistic for that equation.

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▷ Example 3: After svar

When `vargranger` is run on `svar` or `ivsvar` estimates, the null hypotheses are with respect to the underlying `var` estimates. We run `vargranger` after using `svar` to fit an SVAR model that has the same underlying VAR model as our model in example 1.

```
. matrix A = (., 0,0 \ ., ., 0\ .,.,.)
. matrix B = I(3)
. svar dln_inv dln_inc dln_consump if qtr<=tq(1978q4), dfk small aeq(A) beq(B)
  (output omitted )
. vargranger
  Granger causality Wald tests
```

Equation	Excluded	F	df	df_r	Prob > F
dln_inv	dln_inc	.04847	2	66	0.9527
dln_inv	dln_consump	1.5004	2	66	0.2306
dln_inv	ALL	1.5917	4	66	0.1869
dln_inc	dln_inv	1.7683	2	66	0.1786
dln_inc	dln_consump	1.7184	2	66	0.1873
dln_inc	ALL	1.9466	4	66	0.1130
dln_consump	dln_inv	.97147	2	66	0.3839
dln_consump	dln_inc	6.1465	2	66	0.0036
dln_consump	ALL	3.7746	4	66	0.0080

As we expected, the `vargranger` results are identical to those in the first example.

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Stored results

`vargranger` stores the following in `r()`:

Matrices
r(gstats)	χ^2, df, and p-values (if e(small)=="")
r(gstats)	F, df, df_r, and p-values (if e(small)!="")

Methods and formulas

`vargranger` uses `test` to obtain Wald statistics of the hypothesis that all coefficients on the lags of variable x are jointly zero in the equation for variable y. `vargranger` uses the e() results stored by `var`, `svar`, or `ivsvar` to determine whether to calculate and report small-sample F statistics or large-sample χ^2 statistics. `vargranger` always reports large-sample χ^2 statistics after `xtvar`.

Clive William John Granger (1934–2009) was born in Swansea, Wales, and earned degrees in mathematics and statistics at the University of Nottingham. Joining the staff there, he also worked at Princeton on the spectral analysis of economic time series before moving in 1974 to the University of California, San Diego. He was awarded the 2003 Nobel Prize in Economics for methods of analyzing economic time series with common trends (cointegration). He was knighted in 2005, thus becoming Sir Clive Granger.

References

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Also see

[TS] **var** — Vector autoregressive models[+]

[TS] **var intro** — Introduction to vector autoregressive models

[TS] **var ivsvar** — Instrumental-variables structural vector autoregressive models[+]

[TS] **var svar** — Structural vector autoregressive models

[TS] **varbasic** — Fit a simple VAR and graph IRFs or FEVDs

[XT] **xtvar** — Panel-data vector autoregressive models[+]

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