Technical tips on time series with Stata

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STATA Data Analysis and Statistical Software

Outline

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  - tsset
  - Date formats
- Tip 2: Why some predictions with -arima- do not match my manual computations - Kalman Filter recursions
- Tip 3: What is the initial shock for impulse response functions after -var-
- Tip 4: How do I fit my unobserved component model with –sspace-
  - linear regression and random walk
- Tip 5: How do I specify restrictions on the long-run cointegrating relationship in the VEC model

TIP 1:Specifying the time structure

- tsset timevar [, options]
  - Date frequency (daily, weekly, monthly,…)
  - Clocktime (hours, minutes, seconds,…, milliseconds)
  - Generic
  - delta()

  Example:

  tsset timevar,daily delta(7)

  lags in terms of seven days

TIP 1:Specifying the time structure

- Date formats
  - Example – Daily format

```
clear
input       str12     date
                  "1/01/2008"
                  "1/02/2008"
                  "1/03/2008"
                  "1/04/2008"
                  "1/05/2008"
end
generate mydate1=date(date,"DMY")
format    mydate1 %td
generate mydate2=date(date,"DMY“)
format    mydate2 %tdmon-DD,_CCYY
```

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TIP 1:Specifying the time structure

- Date formats
  - Example – Daily format

```
.   list date mydate1 mydate2

     +---------------------------------------+
     |       date     mydate1     mydate2    |
     |---------------------------------------|
  1. | 1/01/2008   01jan2008   jan-01, 2008 |
  2. | 1/02/2008   01feb2008   feb-01, 2008 |
  3. | 1/03/2008   01mar2008   mar-01, 2008 |
  4. | 1/04/2008   01apr2008   apr-01, 2008 |
  5. | 1/05/2008   01may2008   may-01, 2008 |
     +---------------------------------------+
```

TIP 1:Specifying the time structure

- Date formats
  - Example – Daily format

```
. tsset mydate1
  time variable: mydate1, 01jan2008 to 01may2008,
                 but with gaps
          delta: 1 day

.  list mydate1 if tin(01feb2008,01apr2008)

     +-----------+
     |   mydate1 |
     |-----------|
  2. | 01feb2008 |
  3. | 01mar2008 |
  4. | 01apr2008 |
     +-----------+
```

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TIP 1:Specifying the time structure

- Date formats
  - Example – Clock format

```
clear
Input          str20   etime        y
         "06feb2010 12:40:00"     2
         "06feb2010 12:42:00"     5
         "06feb2010 12:44:00"     7
         "06feb2010 12:46:00"     6
         "06feb2010 12:48:00"     9
end

generate double mytime = clock(etime, "DMY hms")
format mytime %tc DMYHH:MM:SS
```

TIP 1:Specifying the time structure

- Date formats
  - Example – Clock format

```
. tsset mytime,delta(2 minute)
    time variable: mytime, 06feb2010 12:40:00 to 06feb2010 12:48:00
            delta:  2 minutes

. generate my_ly=l.y
(1 missing value generated)

. list mytime y ly my_ly

     +-----------------------------------+
     |             mytime   y     my_ly |
     |-----------------------------------|
  1. | 06feb2010 12:40:00   2         . |
  2. | 06feb2010 12:42:00   5         2 |
  3. | 06feb2010 12:44:00   7         5 |
  4. | 06feb2010 12:46:00   6         7 |
  5. | 06feb2010 12:48:00   9         6 |
     +-----------------------------------+
```

TIP 2: Predictions with -arima- Kalman Filter recursions

- Let's consider the following moving average (MA1) model:

$$y_t = \alpha + \theta\varepsilon_{t-1} + \varepsilon_t \quad ; \quad \varepsilon_t \sim i.i.d.N(0,\sigma^2)$$

Command line to fit the model:	arima y, ma(1)
And we get the predictions with:	predict double y_hat

TIP 2: Predictions with -arima-
Kalman Filter recursions

- Users try to manually reproduce the predictions with:

$$\hat{Y}_t = \hat{\alpha} + \hat{\theta} \times \hat{\epsilon}_{t-1}$$

$$\hat{\epsilon}_{t-1} = Y_{t-1} - \hat{Y}_{t-1}$$

- However, the results do not match the predictions obtained with:

```
predict double y_hat
```

WHY?

TIP 2: Predictions with -arima- Kalman Filter recursions

- Code for manual predictions

```
use http://www.stata-press.com/data/r11/lutkepohl,clear
arima dlinvestment, ma(1)
predict double yhat
scalar b0 = _b[_cons]
scalar t1 = [ARMA]_b[L1.ma]
gen double my_yhat = b0
gen double myehat = dlinvestment - b0 in 2
forvalues i = 3/91 {
    qui replace my_yhat = my_yhat  ///
            + t1*L.myehat in `i'
    qui replace myehat = dlinvestment - my_yhat in `i'
}
```

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TIP 2: Predictions with -arima- Kalman Filter recursions

- List first 12 predictions

```
.  list qtr yhat my_yhat in 1/13,sep(11)

     +--------------------------------+
     |    qtr        yhat     my_yhat |
     |--------------------------------|
  1. | 1960q1    .01686688   .01686688 |
  2. | 1960q2    .01686688   .01686688 |
  3. | 1960q3    .02052151   .02062398 |
  4. | 1960q4    .01478403    .0147996 |
  5. | 1961q1    .01312365   .01312617 |
  6. | 1961q2    .00326376   .00326418 |
  7. | 1961q3    .02471242   .02471249 |
  8. | 1961q4    .01691061   .01691062 |
  9. | 1962q1    .01412974   .01412975 |
 10. | 1962q2    .00643301   .00643301 |
 11. | 1962q3    .01940009    .0194001 |
     |--------------------------------|
 12. | 1962q4    .01649863   .01649863 |
 13. | 1963q1    .01749646   .01749646 |
     +--------------------------------+
```

TIP 2: Predictions with -arima- Kalman Filter recursions

- Stata uses the recursive formula for the Kalman filter prediction based on:

$$\hat{\epsilon}_{t-1} = [\frac{\hat{\sigma}^2}{\hat{\sigma}^2 + \hat{\theta}^2 \times p_{t-1}}] \times (Y_{t-1} - \hat{Y}_{t-1}) \qquad \hat{\epsilon}_0 = 0$$

- Where:

$$p_t = [\frac{\hat{\sigma}^2 \times \hat{\theta}^2 \times p_{t-1}}{\hat{\sigma}^2 + \hat{\theta}^2 \times p_{t-1}}] \qquad p_1 = \hat{\sigma}^2$$

$\hat{\sigma}^2$ estimated variance of the white noise disturbance

TIP 2: Predictions with -arima- Kalman Filter recursions

```
use http://www.stata-press.com/data/r11/lutkepohl,clear
arima dlinvestment, ma(1)
predict double yhat
```

**** Coefficient estimates and sigma^2 from ereturn list ****

```
scalar b0 = _b[_cons]
scalar t1 = [ARMA]_b[L1.ma]
scalar sigma2 = e(sigma)^2
```

**** pt and shrinking factor for the first two observations****

```
gen double pt=sigma2 in 1/2
gen double myratio=(sigma2)/(sigma2+t1^2*pt) in 2
```

**** Predicted series and errors for the first two observations ****

```
gen double my_yhat = b0
generate double myehat = myratio*(dlinvestment - my_yhat) in 2
```

**** Predictions with the Kalman filter recursions ****

```
forvalues i = 3/91 {
        qui replace my_yhat = my_yhat + t1*l.myehat in `i'
        qui replace pt= (sigma2)*(t1^2)*(L.pt)/ (sigma2+t1^2*L.pt) in `i'
        qui replace myratio=(sigma2)/(sigma2+t1^2*pt) in `i'
        qui replace myehat=myratio*(dlinvestment - my_yhat) in `i'
}
```

TIP 2: Predictions with -arima- Kalman Filter recursions

- List first 10 predictions

```
. list qtr yhat my_yhat pt myratio in 1/10

     +-----------------------------------------------------------+
     |    qtr        yhat     my_yhat          pt      myratio |
     |-----------------------------------------------------------|
  1. | 1960q1    .01686688   .01686688   .00192542           . |
  2. | 1960q2    .01686688   .01686688   .00192542   .97272668 |
  3. | 1960q3    .02052151   .02052151   .00005251   .99923589 |
  4. | 1960q4    .01478403   .01478403   1.471e-06   .99997858 |
  5. | 1961q1    .01312365   .01312365   4.125e-08    .9999994 |
     |-----------------------------------------------------------|
  6. | 1961q2    .00326376   .00326376   1.157e-09   .99999998 |
  7. | 1961q3    .02471242   .02471242   3.243e-11           1 |
  8. | 1961q4    .01691061   .01691061   9.092e-13           1 |
  9. | 1962q1    .01412974   .01412974   2.549e-14           1 |
 10. | 1962q2    .00643301   .00643301   7.147e-16           1 |
     +-----------------------------------------------------------+
```

TIP 3: Initial shock for Impulse response functions (IRF) after -var-

VAR model

$$\Delta Y_t = \alpha + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \ldots + \beta_p \Delta Y_{t-p} + \varepsilon_t$$

Where:

$Y_t = (Y_{1t}, Y_{2t}, \ldots, Y_{kt})$: I(1) Endogenous variables

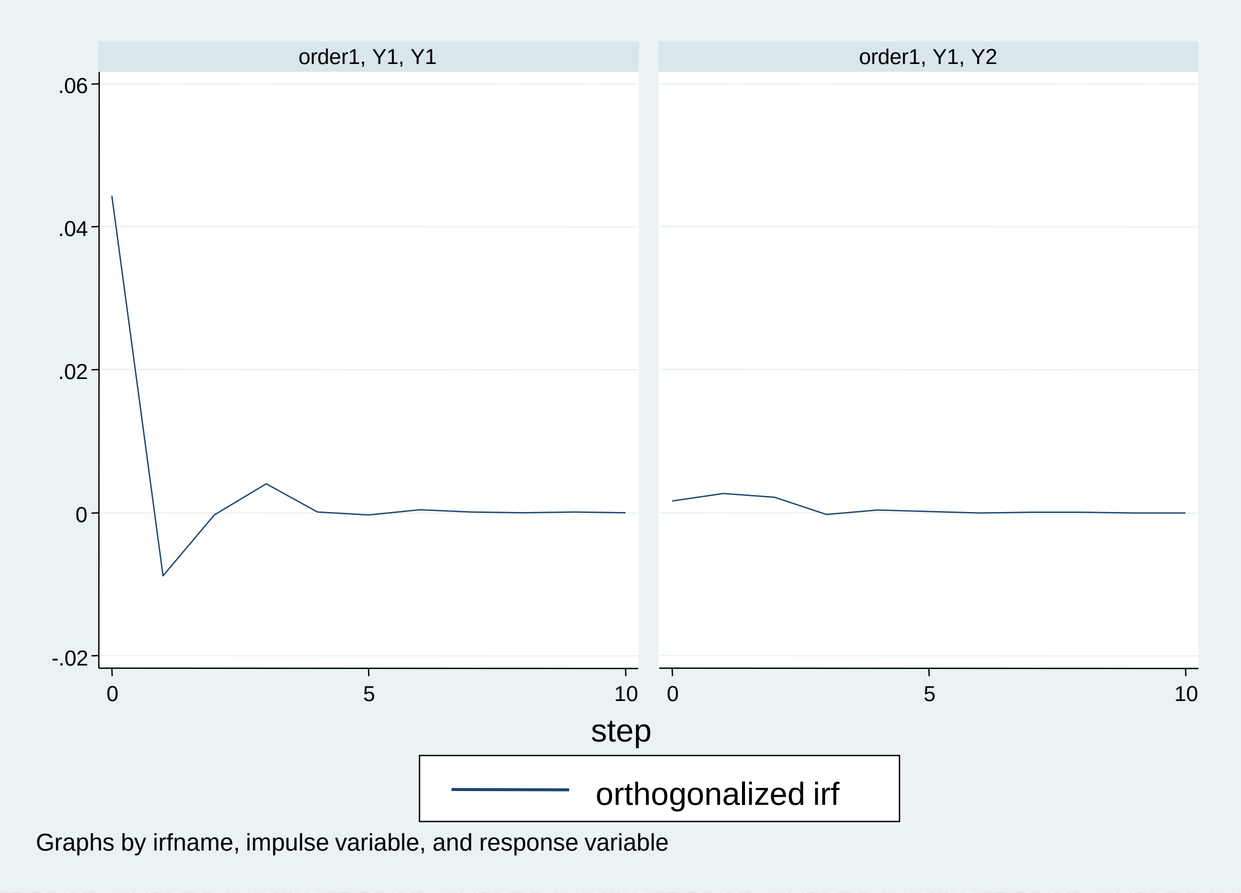
β_i: Matrix with coefficients associated to lag i

α: Vectors with coefficients associated to the intercepts

ε_t: Vector with innovations

TIP 3: Initial shock for Impulse response functions (IRF) after -var-

- Orthogonalized IRF functions for a shock in Y1



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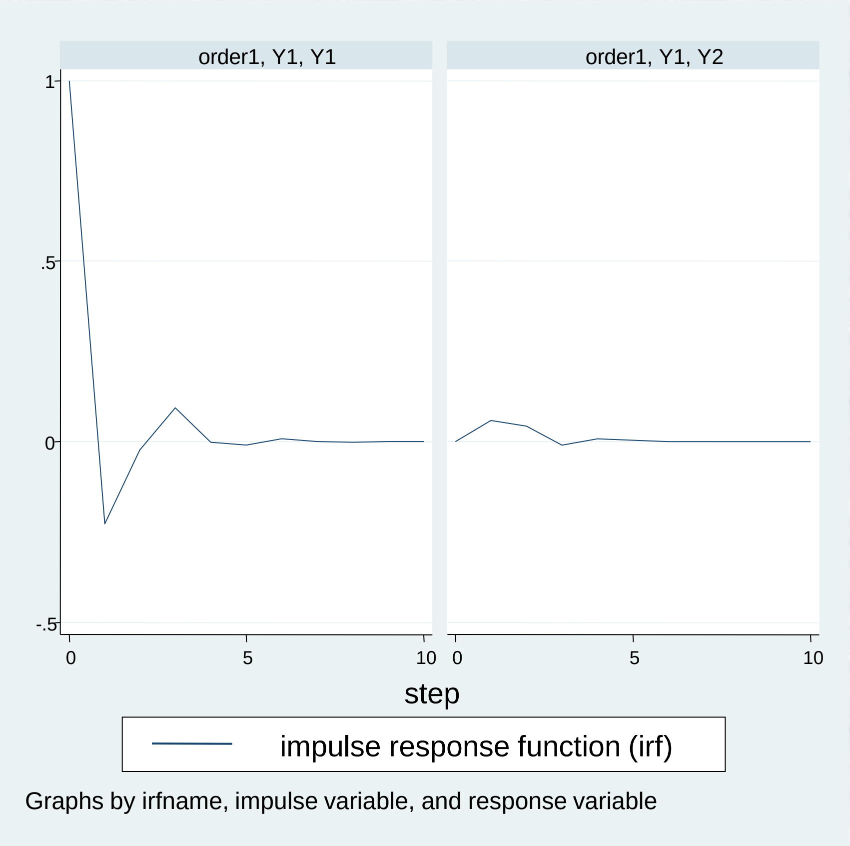
TIP 3: Initial shock for Impulse response functions after -var-

What is the magnitude of the shock in the IRF graph?

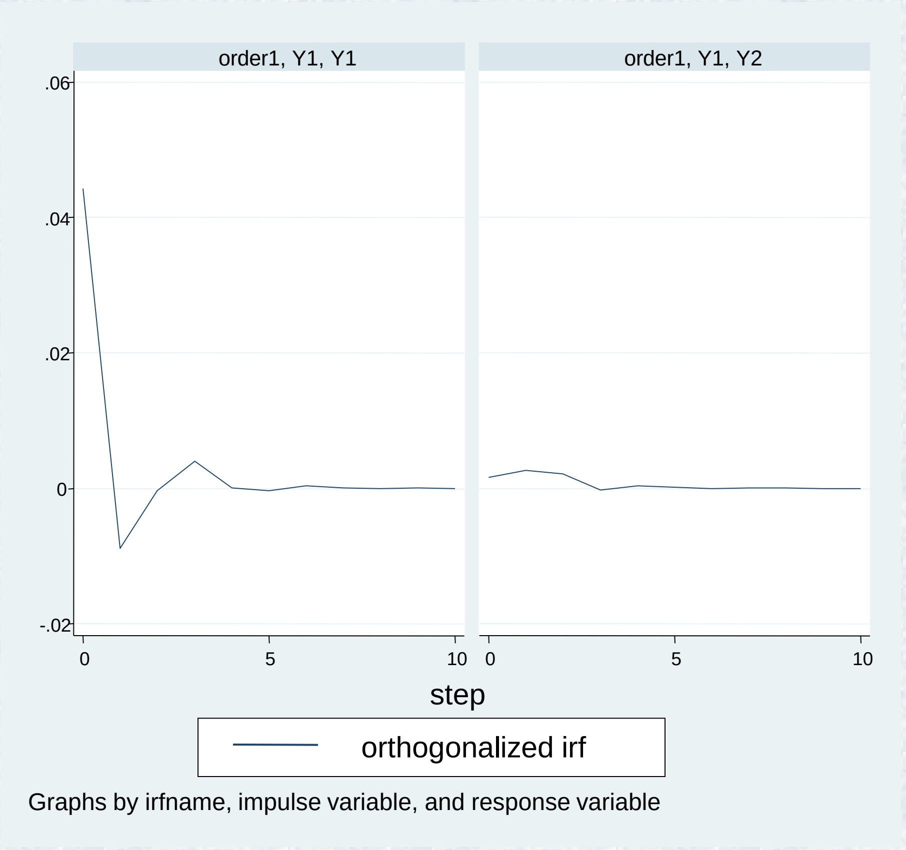
- -irf graph,irf-: simple IRF
  - correspond to one-time unit increase
  - the effects do not have a causal interpretation



TIP 3: Initial shock for Impulse response functions after -var-

What is the magnitude of the shock in the IRF graph?

- -irf graph,oirf-: orthogonal IRF
  - orthogonalization is produced via the Cholesky decomposition
  - the magnitude of the shock corresponds to one unit standard deviation
- -irf graph,sirf- structural IRF
  - -irf graph,sirf- IRF functions are derived from the constraints imposed on the SVAR
  - the magnitude of the shock corresponds to one unit standard deviation



TIP 3: Initial shock for Impulse response functions after -var-

- Let's fit a VAR model:

```
use http://www.stata-press.com/data/r11/lutkepohl

var  dlinvestment dlincome, lags(1/2) dfk
```

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TIP 3: Initial shock for Impulse response functions after -var-

```
. var  dlinvestment dlincome,lags(1/2) dfk

Vector autoregression

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
dlinvestment          5      .04424   0.0856   8.32989   0.0802
dlincome              5     .011403   0.1027   10.1916   0.0373
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
dlinvestment |
dlinvestment |
         L1. |  -.2274192   .1053092    -2.16   0.031    -.4338214    -.021017
         L2. |  -.1159636   .1057698    -1.10   0.273    -.3232686    .0913415
    dlincome |
         L1. |   .7103053   .3948248     1.80   0.072    -.0635372    1.484148
         L2. |   .5149489   .3935121     1.31   0.191    -.2563206    1.286218
       _cons |  -.0012273   .0111362    -0.11   0.912    -.0230539    .0205993
-------------+----------------------------------------------------------------
dlincome     |
dlinvestment |
         L1. |   .0597466   .0271441     2.20   0.028     .0065451    .1129481
         L2. |   .0563513   .0272629     2.07   0.039      .002917    .1097855
    dlincome |
         L1. |   .0209461   .1017687     0.21   0.837    -.1785169     .220409
         L2. |   .0833252   .1014303     0.82   0.411    -.1154745    .2821249
       _cons |   .0150368   .0028704     5.24   0.000     .0094108    .0206627
------------------------------------------------------------------------------
```

TIP 3: Initial shock for Impulse response functions after -var-

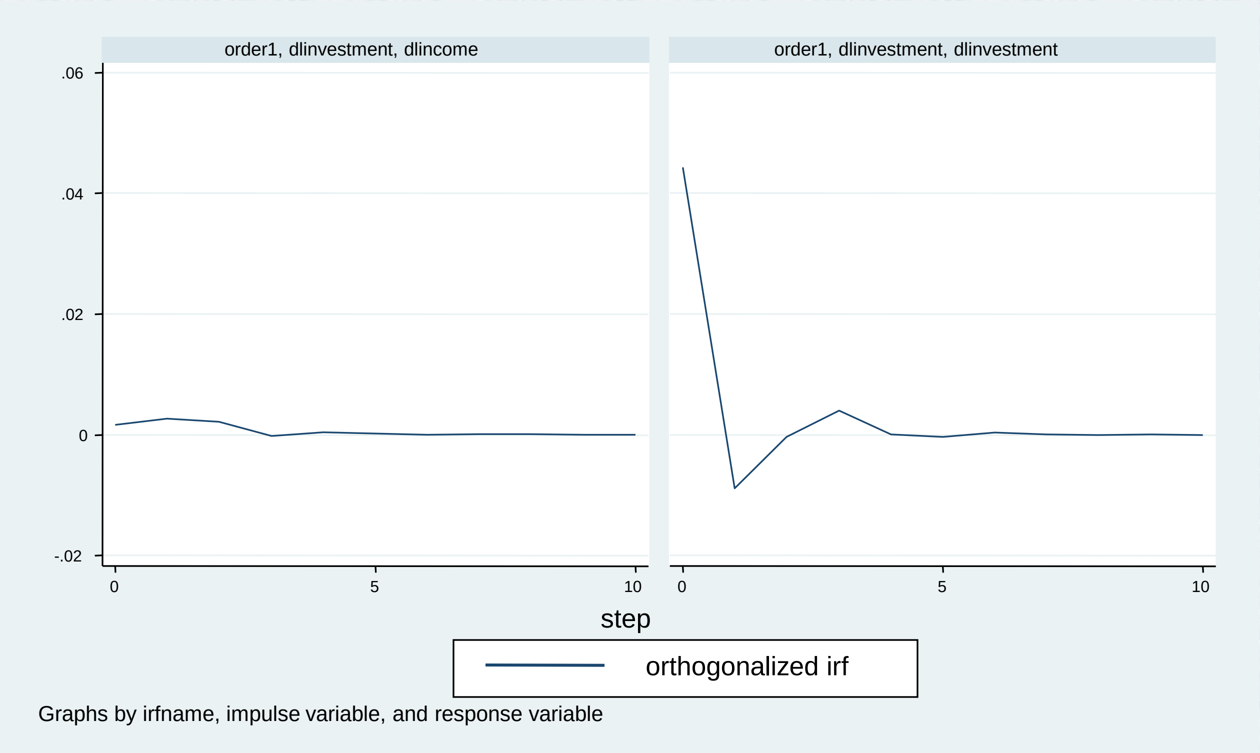
- Plot the IRF function for a shock in dlinvestment

```
use http://www.stata-press.com/data/r11/lutkepohl
var  dlinvestment dlincome, lags(1/2) dfk
irf create order1, step(10) set(myirf1,replace)
irf graph oirf,  impulse(dlinvestment)      ///
          response(dlinvestment dlincome)
```

TIP 3: Initial shock for Impulse response functions after -var-

- Plot the IRF function for a shock in dlinvestment

```
irf graph oirf,  impulse(dlinvestment)    ///
        response(dlinvestment dlincome)
```



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TIP 3: Initial shock for Impulse response functions after -var-

- Table for the OIRF function for a shock in dlinvestment

```
. irf table oirf, irf(order1) impulse(dlinvestment) ///
>       response(dlincome dlinvestment)
```

Results from order1

step	(1) oirf	(1) Lower	(1) Upper	(2) oirf	(2) Lower	(2) Upper
0	.001641	-.000715	.003998	.04424	.037741	.050739
1	.002678	.000241	.005114	-.008895	-.018459	.000669
2	.002154	-.000283	.004592	-.00036	-.009879	.009159
3	-.000255	-.001358	.000849	.004022	-.001068	.009113
4	.000394	-.000347	.001136	.000056	-.002258	.00237
5	.000217	-.000207	.000641	-.00033	-.002245	.001585
6	.000021	-.000237	.000279	.000426	-.000457	.001309
7	.000025	-.000101	.000152	.000068	-.000353	.000488
8	.00003	-.000055	.000116	-.000036	-.000356	.000284
9	4.4e-06	-.000034	.000043	.000035	-.000074	.000143
10	2.7e-06	-.000022	.000027	.000015	-.000063	.000093

95% lower and upper bounds reported
(1) irfname = order1, impulse = dlinvestment, and response = dlincome
(2) irfname = order1, impulse = dlinvestment, and response = dlinvestment

TIP 3: Initial shock for Impulse response functions after -var-

- Table for the IRF function for a shock in dlinvestment

```
.  irf table irf, irf(order1) impulse(dlinvestment) ///
>      response(dlincome dlinvestment)
```

Results from order1

step	(1) irf	(1) Lower	(1) Upper	(2) irf	(2) Lower	(2) Upper
0	0	0	0	1	1	1
1	.059747	.004985	.114509	-.227419	-.439876	-.014963
2	.044015	-.010388	.098419	-.021806	-.237257	.193646
3	-.008218	-.032283	.015847	.093362	-.027102	.213826
4	.007845	-.007056	.022745	-.001875	-.054015	.050264
5	.004629	-.004709	.013967	-.00906	-.054602	.036483
6	.000104	-.005125	.005332	.009605	-.010735	.029945
7	.000451	-.002119	.003022	.001323	-.00833	.010977
8	.000638	-.001136	.002413	-.001041	-.008544	.006462
9	.000063	-.000688	.000814	.000769	-.001641	.003179
10	.000042	-.000454	.000538	.00032	-.001466	.002105

95% lower and upper bounds reported
(1) irfname = order1, impulse = dlinvestment, and response = dlincome
(2) irfname = order1, impulse = dlinvestment, and response = dlinvestment

TIP 4: How do I fit my unobserved component model with –sspace-

- State Space representation

$$z_t = Az_{t-1} + Bx_t + C\varepsilon_t$$

$$y_t = Dz_t + Fw_t + G\upsilon_t$$

Where:

z_t : is an m x 1 vector of unobserved state variables;
x_t : is a k_x x 1 vector of exogenous variables;
ε_t : is a q x 1 vector of state-error terms, (q ≤ m);
y_t : is an n x 1 vector of observed endogenous variables;
w_t : is a k_w x 1 vector of exogenous variables;
υ_t : is an r x 1 vector of observation-error terms, (r ≤ n); and
A, B, C, D, F, and G are parameter matrices.

TIP 4: How do I fit my unobserved component model with –sspace-

- State Space representation for linear regression

$$z_t = \varepsilon_t$$

$$y_t = z_t + \alpha + \beta w_t$$

Command specification

```
constraint 1 [z]L.z = 0
constraint 2 [y]z  = 1
sspace  (z L.z, state noconstant)      ///
          (y w z,noerror ), constraints(1/2)
```

TIP 4:

- State Space estimation for linear regression

```
use http://www.stata-press.com/data/r11/lutkepohl,clear
constraint 1 [z]L.z = 0
constraint 2 [dlinvestment]z  = 1
sspace  (z L.z, state noconstant) (dlinvestment dlincome z,noerror ), constraints(1/2) nolog
```

```
State-space model

Sample: 1960q2 - 1982q4                             Number of obs    =        91
                                                    Wald chi2(1)     =      0.88
Log likelihood =  154.44197                         Prob > chi2      =    0.3487
 ( 1)  [z]L.z = 0
 ( 2)  [dlinvestment]z = 1
------------------------------------------------------------------------------
             |                 OIM
dlinvestment |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
z            |
           z |
         L1. |  (omitted)
-------------+----------------------------------------------------------------
dlinvestment |
           z |          1          .        .       .            .           .
    dlincome |   .3668678   .3914794     0.94   0.349    -.4004178    1.134153
       _cons |   .0096556    .008925     1.08   0.279     -.007837    .0271483
-------------+----------------------------------------------------------------
var(z)       |   .0019651   .0002913     6.75   0.000     .0013941    .0025361
------------------------------------------------------------------------------
Note: Tests of variances against zero are conservative and are provided only for reference.
```

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TIP 4: How do I fit my unobserved component model with –sspace-

- Random Walk $y_t = y_{t-1} + \varepsilon$

- State Space representation
$$z_t = z_{t-1} + \varepsilon_t$$
$$y_t = z_t$$

  - Command specification

```
constraint 1 [z]L.z = 1
constraint 2 [y]z  = 1
sspace  (z L.z, state noconstant)      ///
          (y  z,noerror noconstant), constraints(1/2)
```

TIP 4:

- State Space estimation for Random Walk

```
use http://www.stata-press.com/data/r11/lutkepohl,clear
constraint 1 [z]L.z = 1
constraint 2 [dlinvestment]z  = 1
sspace  (z L.z, state noconstant) (dlinvestment z,noerror noconstant), constraints(1/2) nolog
```

```
State-space model

Sample: 1960q2 - 1982q4                          Number of obs    =         91
Log likelihood =  112.76541
 ( 1)   [z]L.z = 1
 ( 2)   [dlinvestment]z = 1
------------------------------------------------------------------------------
             |                 OIM
dlinvestment |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
z            |
           z |
         L1. |          1          .        .       .            .           .
-------------+----------------------------------------------------------------
dlinvestment |
           z |          1          .        .       .            .           .
-------------+----------------------------------------------------------------
var(z)       |   .0046812   .0006978     6.71   0.000     .0033135     .006049
------------------------------------------------------------------------------
Note: Model is not stationary.
Note: Tests of variances against zero are conservative and are provided only for reference.
```

TIP 5:VEC – Johansen identification

Reduced form for a VEC model

$$\Delta z_t = a + bt - \alpha\beta z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} + \upsilon_t$$

Where:

z_t : I(1) Endogenous variables

$\alpha\beta$: Matrices containing the long-run adjustment coefficients and coefficients for the cointegrating relationships

Γ_i : Matrix with coefficients associated to short-run dynamic effects

a, b : Vectors with coefficients associated to the intercepts and trends

υ_t : Vector with innovations

TIP 5:

Example: VEC with three endogenous variables

$$\begin{bmatrix} \Delta z_{1t} \\ \Delta z_{2t} \\ \Delta z_{3t} \end{bmatrix} = a + bt - \alpha\beta \begin{bmatrix} z_{1t-1} \\ z_{2t-1} \\ z_{3t-1} \end{bmatrix} + \sum_{i=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta z_{1t-i} \\ \Delta z_{2t-i} \\ \Delta z_{3t-i} \end{bmatrix} + \upsilon_t$$

Where:

$$\alpha\beta z_{t-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} \\ \beta_{21} & \beta_{22} & \beta_{23} \end{bmatrix} \begin{bmatrix} z_{1t-1} \\ z_{2t-1} \\ z_{3t-1} \end{bmatrix}$$

- Identifying α and β requires r^2 restrictions (r: number of cointegrating vectors).
- Johansen FIML estimation identifies α and β by imposing r^2 atheoretical restrictions.

$$\alpha\beta z_{t-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \end{bmatrix} \begin{bmatrix} 1 & 0 & \beta_{13} \\ 0 & 1 & \beta_{23} \end{bmatrix} \begin{bmatrix} z_{1t-1} \\ z_{2t-1} \\ z_{3t-1} \end{bmatrix}$$

TIP 5:

- Restrictions based on Johansen normalization (Default)

use http://www.stata-press.com/data/r11/lutkepohl,clear

vec linvestment lincome lconsumption, rank(2) lags(2) noetable trend(none)

```
Vector error-correction model
                 .                 .                 .
                 .                 .                 .
                 .                 .                 .
Identification:  beta is exactly identified

                 Johansen normalization restrictions imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
 linvestment |          1          .        .       .            .           .
     lincome |  (omitted)
lconsumption |  -.7943718   .0125908   -63.09   0.000    -.8190493   -.7696942
-------------+----------------------------------------------------------------
_ce2         |
 linvestment |  (omitted)
     lincome |          1          .        .       .            .           .
lconsumption |  -1.013321   .0013846  -731.87   0.000    -1.016035   -1.010608
------------------------------------------------------------------------------
```

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TIP 5:

Instead of the Johansen atheoretical restrictions we could Use economic theory to impose restrictions to identify αβ.

For example, let's assume the following cointegrating equations:

$$z_{1t-1} = 0.75 z_{2t-1} + \beta_{13} z_{3t-1}$$

$$z_{3t-1} = .85 z_{2t-1} + \beta_{21} z_{1t-1}$$

Which implies

$$\alpha\beta z_{t-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \end{bmatrix} \begin{bmatrix} 1 & -.75 & \beta_{13} \\ \beta_{21} & -.85 & 1 \end{bmatrix} \begin{bmatrix} z_{1t-1} \\ z_{2t-1} \\ z_{3t-1} \end{bmatrix}$$

TIP 5:

- Restrictions specified by the user

```
constraint define 1 [_ce1]linvestment=1
constraint define 2 [_ce1]lincome=-.75
constraint define 3 [_ce2]lconsumption=1
constraint define 4 [_ce2]lincome=-.85
vec linvestment lincome lconsumption, rank(2) lags(2) noetable trend(none) bconstraints(1/4)
```

```
Identification:  beta is exactly identified

 ( 1)  [_ce1]linvestment = 1
 ( 2)  [_ce1]lincome = -.75
 ( 3)  [_ce2]lconsumption = 1
 ( 4)  [_ce2]lincome = -.85
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
 linvestment |          1          .        .       .            .           .
     lincome |       -.75          .        .       .            .           .
lconsumption |  -.0343804   .0122816    -2.80   0.005    -.0584519    -.010309
-------------+----------------------------------------------------------------
_ce2         |
 linvestment |  -.1745742     .00322   -54.22   0.000    -.1808852   -.1682632
     lincome |       -.85          .        .       .            .           .
lconsumption |          1          .        .       .            .           .
------------------------------------------------------------------------------
```

Summary

- Tip 1: Specifying the time structure
- Tip 2: Predictions with –arima-. Kalman Filter recursions
- Tip 3: Initial shock for Impulse response functions after -var-
- Tip 4: Unobserved component models with –sspace-
- Tip 5: Restrictions on cointegrating relationship for VEC models

Stata Data Analysis and Statistical Software

Technical tips on time series with Stata

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