

# Package ‘SIRE’

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**Type** Package

**Title** Finding Feedback Effects in SEM and Testing for Their Significance

**Version** 1.1.0

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**Description** Provides two main functionalities.

1 - Given a system of simultaneous equation, it decomposes the matrix of coefficients weighting the endogenous variables into three submatrices: one includes the subset of coefficients that have a causal nature in the model, two include the subset of coefficients that have a interdependent nature in the model, either at systematic level or induced by the correlation between error terms.

2 - Given a decomposed model, it tests for the significance of the interdependent relationships acting in the system, via Maximum likelihood and Wald test, which can be built starting from the function output. For theoretical reference see Faliva (1992) <[doi:10.1007/BF02589085](https://doi.org/10.1007/BF02589085)> and Faliva and Zoia (1994) <[doi:10.1007/BF02589041](https://doi.org/10.1007/BF02589041)>.

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Depends** R (>= 3.1.0)

**Imports** systemfit, psych, igraph, matrixcalc, MASS, numDeriv, Matrix, stringr, Rsolnp, dplyr, magrittr

**RoxygenNote** 6.0.1

**NeedsCompilation** no

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causal_decompose	<i>Estimation and decomposition of simultaneous equation model</i>
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## Description

Estimate and/or decompose a Simultaneous Equation Model into its recursive and Interdependent sub-systems

## Usage

```
causal_decompose(data, eq.system, resid.est = "noDfCor", instruments,
  sigma.in = NULL)
```

## Arguments

data	the data frame containing the data
eq.system	the system of equations (a list of formula objects, e.g. as in pkg systemfit)
resid.est	the estimation methods for the residual covariance matrix (as in systemfit)
instruments	the intruments used to estimate the model via 3-SLS (as in systemfit)
sigma.in	the $\Sigma$ matrix, if the user wants to simulate a particular structure at stochastic level. Overrides 3SLS estimation if specified.

## Value

A list with components

- eq.system: the system of equations given as input
- Gamma: the 3-SLS estimate of  $\Gamma'$
- C: the matrix highlighting the interdependent mechanisms at deterministic level.
- Psi1: the matrix highlighting the interdependent mechanisms at stochastic level.
- Psi0: the matrix highlighting the causal mechanisms.
- A: the 3-SLS estimate of  $A$
- Sigma: the 3-SLS estimate of  $\Sigma$
- systemfit: the output from the systemfit function used to estimate the model
- all.graph: the path diagram of the model, using the package igraph
- dec.graph: the path diagram of the decomposed model, with color coding for each vertex
- type.out: the type of analysis performed, either 'simulation' or 'empirical'

**Examples**

```

data("macroIT")
eq.system = list(
  eq1 = C ~ CP + I + CP_1,
  eq2 = I ~ K + CP_1,
  eq3 = WP ~ I + GDP + GDP_1,
  eq4 = GDP ~ C + I + GDP_1,
  eq5 = CP ~ WP + T,
  eq6 = K ~ I + K_1)

instruments = ~ T + CP_1 + GDP_1 + K_1

causal_decompose(data = macroIT,
  eq.system = eq.system,
  resid.est = "noDfCor",
  instruments = instruments,
  sigma.in = NULL)

```

dec\_calc

*Decomposition starting from Gamma and Sigma***Description**

Function to decompose  $\Gamma'$  into recursive and interdependent sub-matrices (internal use)

**Usage**

```
dec_calc(Gamma, Sigma)
```

**Arguments**

Gamma	the $\Gamma'$ matrix.
Sigma	the $\Sigma$ matrix.

**Value**

A list with components

- C: the matrix highlighting the interdependent mechanisms at deterministic level.
- Psi1: the matrix highlighting the interdependent mechanisms at stochastic level.
- Psi0: the matrix highlighting the causal mechanisms.
- powers: a list containing the matrix powers of  $\Gamma'$ .

feedback\_ml

*Testing for Feedback Effects in a Simultaneous Equation Model***Description**

Testing for Feedback Effects in a Simultaneous Equation Model

**Usage**

```
feedback_ml(data, out.decompose, eq.id, lb = -200, ub = 200,
            nrestarts = 10, nsim = 20000, seed.in = 1)
```

**Arguments**

data	the data frame containing the data
out.decompose	the decomposition object resulting from <code>causal_decompose()</code>
eq.id	the equation to be tested for feedback effects
lb	lower bound of the parameter space required for <code>gosolnp</code>
ub	upper bound of the parameter space required for <code>gosolnp</code>
nrestarts	number of solver restarts (as in <code>gosolnp</code> )
nsim	number of random parameters to generate for every restart of the solver (as in <code>gosolnp</code> )
seed.in	seed number for <code>gosolnp</code> routine

**Value**

A list with components

- `rho.est`: a data frame with the maximum likelihood estimate of  $\rho$  and the equations with which each element is involved in feedback-like mechanisms
- `loglik`: the value of the log-likelihood of the model
- `theta.hessian`: the hessian matrix for the estimated parameters
- `rho.jacobian`: the Jacobian matrix of  $\rho$  with respect to the entire set of parameters
- `wald`: the resulting Wald test statistic

**Examples**

```
data("macroIT")
eq.system = list(
  eq1 = C ~ CP + I + CP_1,
  eq2 = I ~ K + CP_1,
  eq3 = WP ~ I + GDP + GDP_1,
  eq4 = GDP ~ C + I + GDP_1,
  eq5 = CP ~ WP + T,
  eq6 = K ~ I + K_1)
```

```
instruments = ~ T + CP_1 + GDP_1 + K_1

c.dec = causal_decompose(data = macroIT,
                        eq.system = eq.system,
                        resid.est = "noDfCor",
                        instruments = instruments)

feedback_ml(data = macroIT,
            out.decompose = c.dec,
            eq.id = 5,
            lb = -200,
            ub = 200,
            nrestarts = 10,
            nsim = 20000,
            seed.in = 1)
```

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macroIT

*Italian Macroeconomic Data*

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## Description

Italian macroeconomic variables from Q3-1996 to Q2-2011 (T = 60 observations). The variables are

- QTR: quarter and year of the observation
- C: expenses for consumption for Italian families
- CP: value added
- WP: private wages from dependent employment
- I: gross investment
- K: gross capital stock
- GDP: gross domestic product
- T: taxes
- CP\_1: lagged value added
- K\_1: lagged gross capital stock
- GDP\_1: lagged gross domestic product

## Usage

```
data(macroIT)
```

## Format

An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 60 rows and 11 columns.

**Source**

<http://dati.istat.it/>

**Examples**

```
data(macroIT)
```

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rho\_calc

*Rho Calculation*

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**Description**

Function to calculate rho (internal use)

**Usage**

```
rho_calc(l, Gamma, A, Sigma)
```

**Arguments**

l	the equation index for which to calculate rho
Gamma	the $\Gamma'$ matrix
A	the $A$ matrix
Sigma	the $\Sigma$ matrix

**Value**

A list with components

- S0: the selection matrix for  $p_j$ .
- S1: the selection matrix for  $\Gamma'$ .
- S2: the selection matrix. for  $A$

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