

# Package ‘pdynmc’

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**Type** Package

**Title** Moment Condition Based Estimation of Linear Dynamic Panel Data Models

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**Depends** R (>= 3.6.0)

**Imports** data.table (>= 1.12.2), dplyr (>= 0.8.3), MASS (>= 7.3-51.4),  
Matrix (>= 1.2-17), optimx (>= 2018-07.10), qlcMatrix (>=  
0.9.7), stats (>= 3.6.0), Rdpack (>= 0.11-0)

**Suggests** plm (>= 2.2-0), testthat, R.rsp (>= 0.43.2)

**RdMacros** Rdpack

**Description** Linear dynamic panel data modeling based on linear and nonlinear moment conditions as proposed by Holtz-Eakin, Newey, and Rosen (1988) <doi:10.2307/1913103>, Ahn and Schmidt (1995) <doi:10.1016/0304-4076(94)01641-C>, and Arellano and Bover (1995) <doi:10.1016/0304-4076(94)01642-D>. Estimation of the model parameters relies on numerical optimization and the computation of closed form solutions. For inference and specification testing, Windmeijer (2005) <doi:10.1016/j.jeconom.2004.02.005> corrected standard errors, serial correlation tests, tests for overidentification, and Wald tests are available.

**License** GPL (>= 2)

**URL** <https://github.com/markusfritsch/pdynmc>

**BugReports** <https://github.com/markusfritsch/pdynmc/issues>

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fitted.pdynmc	<i>Extract fitted values.</i>
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### Description

fitted.pdynmc extracts fitted values of an object of class 'pdynmc'.

### Usage

```
## S3 method for class 'pdynmc'
fitted(object, step = object$iter, na.rm = FALSE, ...)
```

### Arguments

object	An object of class 'pdynmc'.
step	An integer denoting the iteration step for which fitted values are extracted (defaults to last iteration step used for obtaining parameter estimates).
na.rm	A logical variable indicating whether missing values should be removed from the vector of fitted values (defaults to 'FALSE').
...	further arguments.

### Value

Extract fitted values from object of class 'pdynmc'.

**See Also**

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
fitted(m1, na.rm = TRUE)

## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

## Further code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
fitted(m1, na.rm = TRUE)
```

---

jtest.fct

*Hansen J test.*


---

**Description**

jtest.fct tests the validity of the overidentifying restrictions.

**Usage**

```
jtest.fct(object)
```

**Arguments**

object            An object of class ‘pdynmc’.

**Details**

The null hypothesis is that the overidentifying restrictions are valid. The test statistic is computed as proposed by Hansen (1982). As noted by Bowsher (2002) and Windmeijer (2005) the test statistic is weakened by many instruments.

**Value**

An object of class ‘htest’ which contains the Hansen J test statistic and corresponding p-value for the null hypothesis that the overidentifying restrictions are valid.

**References**

Bowsher CG (2002). “On testing overidentifying restrictions in dynamic panel data models.” *Economics Letters*, **77**(2), 211–220. doi: [10.1016/S01651765\(02\)001301](https://doi.org/10.1016/S01651765(02)001301).

Hansen LP (1982). “Large Sample Properties of Generalized Method of Moments Estimators.” *Econometrica*, **50**(4), 1029–1054. doi: [10.2307/1912775](https://doi.org/10.2307/1912775).

Windmeijer F (2005). “A finite sample correction for the variance of linear efficient two-step GMM estimators.” *Journal of Econometrics*, **126**(1), 25–51. doi: [10.1016/j.jeconom.2004.02.005](https://doi.org/10.1016/j.jeconom.2004.02.005).

**See Also**

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(140:0), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
jtest.fct(m1)
```

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

## Further code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
jtest.fct(m1)
```

---

mtest.fct

*Arellano and Bond serial correlation test.*


---

### Description

mtest.fct tests for serial correlation in the error terms.

### Usage

```
mtest.fct(object, t.order)
```

### Arguments

object	An object of class ‘pdynmc’.
t.order	A number denoting the order of serial correlation to test for.

### Details

The null hypothesis is that there is no serial correlation of a particular order. The test statistic is computed as proposed by Arellano and Bond (1991).

### Value

An object of class ‘htest’ which contains the Arellano and Bond m test statistic and corresponding p-value for the null hypothesis that there is no serial correlation of the given order.

## References

Arellano M, Bond S (1991). “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations.” *The Review of Economic Studies*, **58**(2), 277–297. doi: [10.2307/2297968](https://doi.org/10.2307/2297968).

## See Also

[pdynmc](#) for fitting a linear dynamic panel data model.

## Examples

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(140:0), ]
```

```
## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
mtest.fct(m1, t.order = 2)
```

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
```

```
## Further code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
mtest.fct(m1, t.order = 2)
```

---

pdynmc	<i>pdynmc: A package for moment conditions based estimation of linear dynamic panel data models</i>
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---

## Description

The pdynmc package provides three categories of functions that are available to the user: A function for model fitting, functions for specification testing, and functions that extract and summarize particular information from fitted model objects.

pdynmc fits a linear dynamic panel data model based on moment conditions with the Generalized Method of Moments (GMM).

## Usage

```
pdynmc(  
  dat,  
  varname.i,  
  varname.t,  
  use.mc.diff,  
  use.mc.lev,  
  use.mc.nonlin,  
  use.mc.nonlinAS = NULL,  
  inst.stata = FALSE,  
  include.y,  
  varname.y = NULL,  
  lagTerms.y = NULL,  
  maxLags.y = NULL,  
  include.x = FALSE,  
  varname.reg.end = NULL,  
  lagTerms.reg.end = NULL,  
  maxLags.reg.end = NULL,  
  varname.reg.pre = NULL,  
  lagTerms.reg.pre = NULL,  
  maxLags.reg.pre = NULL,  
  varname.reg.ex = NULL,  
  lagTerms.reg.ex = NULL,  
  maxLags.reg.ex = NULL,  
  include.x.instr = FALSE,  
  varname.reg.instr = NULL,  
  include.x.toInstr = FALSE,  
  varname.reg.toInstr = NULL,  
  fur.con = FALSE,  
  fur.con.diff = NULL,  
  fur.con.lev = NULL,  
  varname.reg.fur = NULL,  
  lagTerms.reg.fur = NULL,
```

```

include.dum = TRUE,
dum.diff = NULL,
dum.lev = TRUE,
varname.dum = NULL,
col_tol = 0.65,
w.mat = "iid.err",
w.mat.stata = FALSE,
std.err = "corrected",
estimation = "twostep",
max.iter = NULL,
iter.tol = NULL,
inst.thresh = NULL,
opt.meth = "BFGS",
hessian = FALSE,
optCtrl = list(kkt = FALSE, kkttol = .Machine$double.eps^(1/3), kkt2tol =
  .Machine$double.eps^(1/3), starttests = TRUE, dowarn = TRUE, badval = (0.25) *
  .Machine$double.xmax, usenumDeriv = FALSE, reltol = 1e-12, maxit = 200, trace = TRUE,
  follow.on = FALSE, save.failures = TRUE, maximize = FALSE, factr = 1e+07, pgtol = 0,
  all.methods = FALSE),
custom.start.val = FALSE,
start.val = NULL,
start.val.lo = -1,
start.val.up = 1,
seed.input = 42
)

```

### Arguments

<code>dat</code>	A data set.
<code>varname.i</code>	The name of the cross-section identifier.
<code>varname.t</code>	The name of the time-series identifier.
<code>use.mc.diff</code>	A logical variable indicating whether moment conditions from equations in differences (i.e. instruments in levels) should be used.
<code>use.mc.lev</code>	A logical variable indicating whether moment conditions from equations in levels (i.e. instruments in differences) should be used.
<code>use.mc.nonlin</code>	A logical variable indicating whether nonlinear (quadratic) moment conditions should be used.
<code>use.mc.nonlinAS</code>	A logical variable indicating whether only the nonlinear (quadratic) moment conditions in the form proposed by Ahn and Schmidt (1995) should be used (defaults to 'TRUE').
<code>inst.stata</code>	A logical variable indicating whether to use the moment conditions from equations in levels as in Stata implementations <code>xtabond2</code> Roodman (2018) and <code>xtdpdgm</code> Kripfganz (2019).
<code>include.y</code>	A logical variable indicating whether instruments should be derived from the lags of the response variable.



varname.y	A character string denoting the name of the response variable in the data set.
lagTerms.y	An integer indicating the number of lags of the dependent variable used as explanatory variables.
maxLags.y	An integer indicating the maximum number of lags of the dependent variable from which instruments should be derived.
include.x	A logical variable indicating whether instruments should be derived from the covariates. Setting the argument to 'TRUE' requires specifying whether the covariates are endogenous, predetermined, or (strictly) exogenous (defaults to 'FALSE').
varname.reg.end	One or more character strings denoting the covariate(s) in the data set to be treated as endogenous (defaults to 'NULL').
lagTerms.reg.end	One or more integers indicating the number of lags of the endogenous covariate(s) used as explanatory variables. One integer per covariate needs to be given in the same order as the covariate names (defaults to 'NULL').
maxLags.reg.end	One or more integers indicating the maximum number of lags of the endogenous covariate(s) used for deriving instruments. One integer per covariate needs to be given in the same order as the covariate names (defaults to 'NULL').
varname.reg.pre	One or more character strings denoting the covariate(s) in the data set to be treated as predetermined (defaults to 'NULL').
lagTerms.reg.pre	One or more integers indicating the number of lags of the predetermined covariate(s) used as explanatory variables. One integer per covariate needs to be given in the same order as the covariate name (defaults to 'NULL').
maxLags.reg.pre	One or more integers indicating the maximum number of lags of the predetermined covariate(s) used for deriving instruments. One integer per covariate needs to be given in the same order as the covariate names (defaults to 'NULL').
varname.reg.ex	One or more character strings denoting the covariate(s) in the data set to be treated as (strictly) exogenous (defaults to 'NULL').
lagTerms.reg.ex	One or more integers indicating the number of lags of the (strictly) exogenous covariate(s) used as explanatory variables. One integer per covariate needs to be given in the same order as the covariate name (defaults to 'NULL').
maxLags.reg.ex	One or more integers indicating the maximum number of lags of the (strictly) exogenous covariate(s) used for deriving instruments. One integer per covariate needs to be given in the same order as the covariate names (defaults to 'NULL').
include.x.instr	A logical variable that allows to include additional IV-type instruments (i.e., include covariates which are used as instruments but for which no parameters are estimated; defaults to 'FALSE').
varname.reg.instr	One or more character strings denoting the covariate(s) in the data set treated as instruments in IV-estimation (defaults to 'NULL').

<code>include.x.toInstr</code>	A logical variable that allows to instrument covariates (i.e., include covariates for which parameters are estimated but which are not employed in estimation; defaults to 'FALSE').
<code>varname.reg.toInstr</code>	One or more character strings denoting the covariates in the data set to be instrumented (i.e., covariates which are used as instruments but for which no parameters are estimated; defaults to 'FALSE').
<code>fur.con</code>	A logical variable indicating whether further control variables (covariates) are included (defaults to 'FALSE').
<code>fur.con.diff</code>	A logical variable indicating whether to include further control variables in equations from differences (defaults to 'NULL').
<code>fur.con.lev</code>	A logical variable indicating whether to include further control variables in equations from level (defaults to 'NULL').
<code>varname.reg.fur</code>	One or more character strings denoting covariate(s) in the data set to treat as further controls (defaults to 'NULL').
<code>lagTerms.reg.fur</code>	One or more integers indicating the number of lags of the further controls to be used as explanatory variables. One integer per further control needs to be given in the same order as the corresponding variable names (defaults to 'NULL').
<code>include.dum</code>	A logical variable indicating whether dummy variables for the time periods are included (defaults to 'FALSE').
<code>dum.diff</code>	A logical variable indicating whether dummy variables are included in the equations in first differences (defaults to 'FALSE').
<code>dum.lev</code>	A logical variable indicating whether dummy variables are included in the equations in levels (defaults to 'TRUE').
<code>varname.dum</code>	One or more character strings from which time dummies should be derived (can be different from <code>varname.t</code> ; defaults to 'NULL').
<code>col_tol</code>	A numeric variable in [0,1] indicating the absolute correlation threshold for collinearity checks (columns are omitted when pairwise correlations are above the threshold; defaults to 0.65).
<code>w.mat</code>	One of the character strings <code>c("iid.err", "identity", "zero.cov")</code> indicating the type of weighting matrix to use (defaults to "iid.err").
<code>w.mat.stata</code>	A logical variable that slightly adjusts the weighting matrix according to the Stata function <code>xtpdgmm</code> (defaults to 'FALSE').
<code>std.err</code>	One of the character strings <code>c("corrected", "unadjusted")</code> . The former option computes Windmeijer (2005) corrected standard errors (defaults to "corrected").
<code>estimation</code>	One of the character strings <code>c("onestep", "twostep", "iterative")</code> . Denotes the number of iterations of the parameter procedure (defaults to "twostep").
<code>max.iter</code>	An integer indicating the maximum number of iterations (defaults to 'NULL'; if estimation is set to "iterative", 'max.iter' defaults to 100).

<code>iter.tol</code>	A numeric variable in [0,1] indicating the tolerance for determining convergence of the iterative approach (defaults to 'NULL'; if estimation is set to "iterative", <code>iter.tol</code> defaults to 0.01).
<code>inst.thresh</code>	An integer denoting whether to limit the total number of instruments to be used in estimation (defaults to 'NULL').
<code>opt.meth</code>	A character string denoting the numerical optimization procedure. When no nonlinear moment conditions are employed in estimation, closed form estimates can be computed by setting the argument to "none" (defaults to "BFGS"; for details on the further available optimizers see the documentation of package <b>optimx</b> ).
<code>hessian</code>	A logical variable indicating if the hessian matrix should be approximated in optimization (defaults to 'FALSE').
<code>optCtrl</code>	A list of arguments that are passed to <b>optimx</b> . For details on the arguments and the available options see the package documentation.
<code>custom.start.val</code>	A logical variable indicating whether prespecified starting values for the parameters are provided by the user (defaults to 'FALSE'; if set to 'TRUE', starting values need to be provided via argument 'start.val').
<code>start.val</code>	A vector of numeric variables denoting the starting values for the parameter vector for numeric optimization (defaults to 'NULL').
<code>start.val.lo</code>	A numeric variable denoting the lower limit for drawing starting values with uniform density (defaults to -1; ignored if 'custom.start.val' is set to 'TRUE').
<code>start.val.up</code>	A numeric variable denoting the upper limit for drawing starting values with uniform density (defaults to 1; ignored if 'custom.start.val' is set to 'TRUE').
<code>seed.input</code>	An integer used as seed for drawing starting values (defaults to 42; required if <code>custom.start.val</code> is set to 'FALSE').

## Details

The function estimates a linear dynamic panel data model of the form

$$y_{i,t} = y_{i,t-1}\rho_1 + \mathbf{x}'_{i,t}\boldsymbol{\beta} + a_i + \varepsilon_{i,t}$$

where  $y_{i,t-1}$  is the lagged dependent variable,  $\rho_1$  is the lag parameter,  $\mathbf{x}_{i,t}$  are further covariates,  $\boldsymbol{\beta}$  are the corresponding parameters,  $a_i$  is an unobserved individual specific effect, and  $\varepsilon_{i,t}$  is an idiosyncratic remainder component. The model structure accounts for unobserved individual specific heterogeneity and dynamics. Note that the specification given above is simplified for illustrative purposes and more general lag structures are allowed in `pdynmc`.

Estimation of the model parameters in `pdynmc` is based on moment conditions with the generalized method of moments (GMM). Linear dynamic panel data models The moment conditions employed in estimation can be linear and nonlinear in parameters and estimation is carried out iteratively. In case only linear moment conditions are used in estimation, closed form solutions can be for computing parameter estimates – while when nonlinear moment conditions are employed, parameter estimation relies on numerical optimization of the objective function.

'`pdynmc`' provides an implementation of some of the functionality available in the Stata library `xtpdgmm` Kripfganz (2019) and allows for "onestep", "twostep", and "iterative" GMM estimation based on the moment conditions of Holtz-Eakin et al. (1988), Arellano and Bover (1995), and Ahn and Schmidt (1995).

**Value**

An object of class `'c("list","pdynmc)'` with the following elements:

<code>data</code>	a list of elements on which computation of the model fit is based
<code>dep.c1F</code>	a list of vectors containing the dependent variable for the cross-sectional observations
<code>dat.c1F</code>	a list of matrices containing the explanatory variables for the cross-sectional observations
<code>w.mat</code>	a list of weighting matrices for the different estimation steps
<code>H_i</code>	a matrix used to create the weighting matrix for the first estimation step
<code>par.optim</code>	a list of vectors containing the parameter estimates obtained from numerical optimization for the estimation steps
<code>ctrl.optim</code>	a list of control parameters used in numerical optimization for the estimation steps
<code>par.c1Form</code>	a list of vectors containing the parameter estimates obtained from the closed form for the estimation steps
<code>iter</code>	a scalar denoting the number of iteration steps carried out to obtain parameter estimates
<code>fitted</code>	a list for each estimation step that contains a list of vectors of fitted values for each cross-sectional observation
<code>resid</code>	a list for each estimation step that contains a list of vectors of residuals for each cross-sectional observation
<code>vcov</code>	a list of matrices containing the variance covariance matrix of the parameter estimates for each estimation step
<code>stderr</code>	a list of vectors containing the standard errors of the parameter estimates for each estimation step
<code>zvalue</code>	a list of vectors containing the z scores for the parameter estimates for each estimation step
<code>pvalue</code>	a list of vectors containing the p-values for the parameter estimates for each estimation step

It has `'fitted'`, `'residuals'`, `'wmat'`, `'vcov'`, `'summary'`, and `'print.summary'` methods.

**Author(s)**

Markus Fritsch

**References**

Ahn SC, Schmidt P (1995). "Efficient estimation of models for dynamic panel data." *Journal of Econometrics*, **68**(1), 5–27. doi: [10.1016/03044076\(94\)01641C](https://doi.org/10.1016/03044076(94)01641C).

Arellano M, Bover O (1995). "Another look at the instrumental variable estimation of error-components models." *Journal of Econometrics*, **68**(1), 29–51. doi: [10.1016/03044076\(94\)01642D](https://doi.org/10.1016/03044076(94)01642D).

Holtz-Eakin D, Newey Whitney K, Rosen HS (1988). “Estimating Vector Autoregressions with Panel Data.” *Econometrica*, **56**(6), 1371–1395. doi: [10.2307/1913103](https://doi.org/10.2307/1913103) .

Kripfganz S (2019). “XTDPDGMM: Stata module to perform generalized method of moments estimation of linear dynamic panel data models.” <http://EconPapers.repec.org/RePEc:boc:bocode:s458395>.

Roodman D (2018). “xtabond2: Stata module to extend xtabond dynamic panel data estimator.” <https://econpapers.repec.org/software/bocbocode/s435901.htm>.

Windmeijer F (2005). “A finite sample correction for the variance of linear efficient two-step GMM estimators.” *Journal of Econometrics*, **126**(1), 25–51. doi: [10.1016/j.jeconom.2004.02.005](https://doi.org/10.1016/j.jeconom.2004.02.005).

### See Also

[wald.fct](#) for Wald tests, [jtest.fct](#) for the Hansen J test, and [mtest.fct](#) for serial correlation tests. [optimx](#) for details on alternative routines and options for numerical optimization

### Examples

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]
```

```
## Code example
pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
       use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
       include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
       fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
       varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
       include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
       w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
       opt.meth = "none")
```

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
```

```
## Arellano and Bond (1991) estimation in Table 4, column (a1)
pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
       use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
       include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
       fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
       varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
       include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
       w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
```

```

    opt.meth = "none")

## Arellano and Bond (1991) estimation in Table 4, column (a2)
pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
       use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
       include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
       fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
       varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
       include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
       w.mat = "iid.err", std.err = "corrected", estimation = "twostep",
       opt.meth = "none")

## Arellano and Bond (1991) twostep estimation extended by nonlinear moment
## conditions
pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
       use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = TRUE,
       include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
       fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
       varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
       include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
       w.mat = "iid.err", std.err = "corrected", estimation = "twostep",
       opt.meth = "BFGS")

## Arellano and Bond (1991) iterative estimation extended by nonlinear moment
## conditions
pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
       use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = TRUE,
       include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
       fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
       varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
       include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
       w.mat = "iid.err", std.err = "corrected", estimation = "iterative",
       max.iter = 4, opt.meth = "BFGS")

## Arellano and Bond (1991) twostep estimation extended by linear moment
## conditions from equations in levels
pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
       use.mc.diff = TRUE, use.mc.lev = TRUE, use.mc.nonlin = FALSE,
       include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
       fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
       varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
       include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
       w.mat = "iid.err", std.err = "corrected", estimation = "twostep",
       opt.meth = "none")

```

---

`print.summary.pdynmc` *Print summary for objects of class 'pdynmc'.*

---

**Description**

print.summary.pdynmc prints the summary for objects of class 'pdynmc'.

**Usage**

```
## S3 method for class 'summary.pdynmc'
print(
  x,
  digits = max(3, getOption("digits") - 3),
  width = getOption("width"),
  ...
)
```

**Arguments**

x	An object of class 'summary.pdynmc'.
digits	An integer indicating the maximum number of digits to display in the object.
width	Argument is defined as in <a href="#">options</a> .
...	further arguments.

**Value**

Print information on objects of class 'summary.pdynmc'.

**See Also**

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
summary(m1)

## Load data from plm package
data(EmplUK, package = "plm")
```

```

dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
summary(m1)

```

---

residuals.pdynmc      *Extract residuals.*

---

## Description

`residual.pdynmc` extracts residuals of an object of class ‘`pdynmc`’.

## Usage

```

## S3 method for class 'pdynmc'
residuals(object, step = object$iter, na.rm = FALSE, ...)

```

## Arguments

<code>object</code>	An object of class ‘ <code>pdynmc</code> ’.
<code>step</code>	An integer denoting the iteration step for which fitted values are extracted (defaults to last iteration step used for obtaining parameter estimates).
<code>na.rm</code>	A logical variable indicating whether missing values should be removed from the vector of fitted values (defaults to ‘ <code>FALSE</code> ’).
<code>...</code>	further arguments.

## Value

Extract residuals from object of class ‘`pdynmc`’.

## See Also

[pdynmc](#) for fitting a linear dynamic panel data model.



**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
residuals(m1, na.rm = TRUE)

## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

## Further code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
residuals(m1, na.rm = TRUE)
```

---

summary.pdynmc

*Summary for objects of class 'pdynmc'.*


---

**Description**

summary.pdynmc generates the summary for objects of class 'pdynmc'.

**Usage**

```
## S3 method for class 'pdynmc'
summary(object, ...)
```

**Arguments**

object            An object of class 'pdynmc'.  
 ...              further arguments.

**Value**

Object of class 'summary.pdynmc'.

**See Also**

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
summary(m1, na.rm = TRUE)

## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
summary(m1)
```

vcov.pdynmc

*Extract variance covariance matrix.***Description**

vcov.pdynmc extracts variance covariance matrix of the parameter estimates of an object of class 'pdynmc'.

**Usage**

```
## S3 method for class 'pdynmc'
vcov(object, step = object$iter, ...)
```

**Arguments**

object	An object of class 'pdynmc'.
step	An integer denoting the iteration step for which fitted values are extracted (defaults to last iteration step used for obtaining parameter estimates).
...	further arguments.

**Value**

Extract variance covariance matrix of the parameter estimates from object of class 'pdynmc'.

**See Also**

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
vcov(m1)
```

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
vcov(m1)
```

---

 wald.fct

*Wald test.*


---

### Description

wald.fct computes F test statistics and corresponding p-values for ‘pdynmc’ objects.

### Usage

```
wald.fct(param, object)
```

### Arguments

param	A character string that denotes the null hypothesis. Choices are time.dum (i.e., all time dummies are jointly zero), slope (i.e., all slope coefficients are jointly zero), and all (i.e., all dummies and slope coefficients are jointly zero).
object	An object of class ‘pdynmc’.

### Details

The three available null hypothesis are: All time dummies are zero jointly, all slope coefficients are zero jointly, all times dummies and slope coefficients are zero jointly.

### Value

An object of class ‘htest’ which contains the F test statistic and corresponding p-value for the tested null hypothesis.

### See Also

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```

## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(140:0), ]

## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
wald.fct(param = "all", m1)

## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])

## Further code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
wald.fct(param = "all", m1)

```

---

wmat.pdynmc

*Extract weighting matrix.*


---

**Description**

wmat.pdynmc extracts weighting matrix of an object of class 'pdynmc'.

**Usage**

```
wmat.pdynmc(object, step = object$iter, ...)
```

**Arguments**

object	An object of class 'pdynmc'.
step	An integer denoting the iteration step for which fitted values are extracted (defaults to last iteration step used for obtaining parameter estimates).
...	further arguments.

**Value**

Extract weighting matrix from an object of class 'pdynmc'.

**See Also**

[pdynmc](#) for fitting a linear dynamic panel data model.

**Examples**

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
dat <- dat[c(1:140), ]
```

```
## Code example
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
wmat.pdynmc(m1)
```

```
## Load data from plm package
data(EmplUK, package = "plm")
dat <- EmplUK
dat[,c(4:7)] <- log(dat[,c(4:7)])
```

```
m1 <- pdynmc(dat = dat, varname.i = "firm", varname.t = "year",
  use.mc.diff = TRUE, use.mc.lev = FALSE, use.mc.nonlin = FALSE,
  include.y = TRUE, varname.y = "emp", lagTerms.y = 2,
  fur.con = TRUE, fur.con.diff = TRUE, fur.con.lev = FALSE,
  varname.reg.fur = c("wage", "capital", "output"), lagTerms.reg.fur = c(1,2,2),
  include.dum = TRUE, dum.diff = TRUE, dum.lev = FALSE, varname.dum = "year",
  w.mat = "iid.err", std.err = "corrected", estimation = "onestep",
  opt.meth = "none")
wmat.pdynmc(m1)
```

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