# Package 'sdpdth'

March 22, 2021

**Type** Package

**Title** M-Estimator for Threshold Spatial Dynamic Panel Data Model

**Version** 0.2

**Author** Junyue Wu

**Maintainer** Junyue Wu <wu.junyue.p1@dc.tohoku.ac.jp>

**Description** M-estimator for threshold and non-threshold spatial dynamic panel data model. Yang, Z (2018) <doi:10.1016/j.jeconom.2017.08.019>. Wu, J., Matsuda, Y (2021) <doi:10.1007/s43071-021-00008-1>.

**License** MIT + file LICENSE

**Imports** Rcpp (>= 1.0.5), rCMA, matrixcalc, rJava, Matrix

**LinkingTo** Rcpp, RcppArmadillo

**LazyData** true

**Encoding** UTF-8

**RoxygenNote** 7.1.1

**Depends** R (>= 2.10)

**NeedsCompilation** yes

**Repository** CRAN

**Date/Publication** 2021-03-22 15:20:02 UTC

## R topics documented:


sdpdth-package . . . . . 2
data_n . . . . . 2
data_nw . . . . . 2
data_th . . . . . 3
data_w . . . . . 3
msdpd . . . . . 3
msdpdth . . . . . 6
print.msdpd . . . . . 8
print.msdpdth . . . . . 9
wald_test . . . . . 9

**Index** **11**

---

`sdpdth-package` *sdpdth*

---

## Description

M-estimator for threshold and non-threshold spatial dynamic panel data model.

## Author(s)

Junyue Wu <wu.junyue.p1@dc.tohoku.ac.jp>

---

`data_n` *A simulated data set for testing*

---

## Description

A simulated data set for testing

## Usage

```
data_n
```

## Format

An object of class `list` of length 4.

---

`data_nw` *A simulated data set for testing*

---

## Description

A simulated data set for testing

## Usage

```
data_nw
```

## Format

An object of class `matrix` with 12 rows and 12 columns.

## data_th *A simulated data set for testing*

### Description

A simulated data set for testing

### Usage

```
data_th
```

### Format

An object of class `list` of length 8.

## data_w *A simulated data set for testing*

### Description

A simulated data set for testing

### Usage

```
data_w
```

### Format

An object of class `matrix` with 16 rows and 16 columns.

## msdpd *M-estimator for spatial dynamic panel data model*

### Description

Estimating the spatial dynamic panel data model with M-estimator

## Usage

```
msdpd(
  y,
  x,
  w1,
  correction = TRUE,
  hessian_er = FALSE,
  true_range = FALSE,
  max_try = 5,
  w2 = w1,
  w3 = w1,
  no_tf = FALSE,
  model = "full",
  rcpp = TRUE,
  cma_pop_multi = 1
)
```

## Arguments

| | |
|---|---|
| y | matrix, containing regional index (first column), time index (second column, numeric) and dependent variable (third column, numeric). |
| x | matrix, containing regional index (first column), time index (second column, numeric) and regressors (numeric). |
| w1 | matrix, the spatial weight matrix. If w2 and w3 are supplied, the spatial weight matrix for spatial lag. |
| correction | logical, whether to use adjusted score function. Default value is TRUE. |
| hessian_er | logical, whether to output hessian based se. Ignored if correction is set to False. Default value is FALSE. |
| true_range | logical, whether to used the accurate stationary check. Default value is FALSE due to performance reasons. |
| max_try | integer, maximum attempt for the solver. Default value is 5. |
| w2 | matrix, the spatial weight matrix for spatio-temporal lag. Default value is the same as w1. |
| w3 | matrix, the spatial weight matrix for spatial error. Default value is the same as w1. |
| no_tf | logical, whether to account for time effect. Default value is TRUE. |
| model | character, indicates the model used for estimation, can be "full", "slm", "sem", "sltl". See Details. |
| rcpp | logical, whether to use the rcpp implementation to calculate the score function. Default value is TRUE. |
| cma_pop_multi | integer, multiplier for the population size used in CMA-ES. Default value is 1. |

## Details

Estimating the spatial dynamic panel data model with Yang(2018)'s M-estimator

$$y_{ti} = \mu_i + \alpha_t + x_{ti}\beta + \rho y_{t-1,i} + \lambda_1 \sum_{j=1}^{n} w_{1,ij} y_{tj} + \lambda_2 \sum_{j=1}^{n} w_{2,ij} y_{t-1,j} + u_{ti}, u_{ti} = \lambda_3 \sum_{j=1}^{n} w_{3,ij} u_{tj} + v_{ti}, i = 1, \ldots, n, t = 1, \ldots,$$

The minimum number of time-periods is 4. Make sure the rows and columns of w1, w2, and w3 are lined up with the regional index. Sub-models can be specified by argument "model"

- "full" Full model
- "slm" $\lambda_2 = \lambda_3 = 0$
- "sem" $\lambda_1 = \lambda_2 = 0$
- "sltl" $\lambda_3 = 0$

Some suggestions when the optimizer fails:

- Increase max_try
- Increase cma_pop_multi
- try a different submodel

## Value

A list of estimation results of S3 class "msdpd"

- "coefficient" list, coefficients and standard errors
- "model" character, model used for estimation
- "vc_mat" matrix, variance-covariance matrix
- "hessian" matrix, optional, hessian matrix

## References

Yang, Z. (2018). Unified M-estimation of fixed-effects spatial dynamic models with short panels. Journal of Econometrics, 205(2), 423-447.

## Examples

```
data(data_n, data_nw)
result <- msdpd(y = data_n$y, x = data_n$x, w1 = data_nw)
```

`msdpdth` *M-estimator for threshold spatial dynamic panel data model*

## Description

Estimating threshold spatial dynamic panel data model with M-estimator

## Usage

```
msdpdth(
  y,
  x,
  w1,
  th,
  correction = TRUE,
  max_try = 5,
  all_er = FALSE,
  true_range = FALSE,
  residual = FALSE,
  w3 = w1,
  w2 = w1,
  no_tf = FALSE,
  model = "full",
  th_type = "row",
  ini_val = NULL,
  rcpp = TRUE,
  cma_pop_multi = 1
)
```

## Arguments

| | |
|---|---|
| `y` | matrix, containing regional index (first column), time index (second column) and dependent variable (third column). |
| `x` | matrix, containing regional index (first column), time index (second column) and regressors. |
| `w1` | matrix, the spatial weight matrix. If w2 and w3 are supplied, the spatial weight matrix for spatial lag. |
| `th` | data.frame, containing regional index (first column, numeric) and grouping indicator(second column, logical). The number of rows should be the same as the number of regions. |
| `correction` | logical, whether to use adjusted score function. Default value is TRUE. |
| `max_try` | integer, maximum attempt for the solver. Default value is 5. |
| `all_er` | logical, whether to output Hessian and Gamma matrix based se. Ignored if correction is set to FALSE. Default value is FALSE. |

| | |
|---|---|
| true_range | logical, whether to used the accurate stationary check. Default value is FALSE due to performance reasons. |
| residual | logical, whether to output the residual. Default value is FALSE. |
| w3 | matrix, the spatial weight matrix for spatial error. Default value is the same as w1. |
| w2 | matrix, the spatial weight matrix for spatio-temporal lag. Default value is the same as w1. |
| no_tf | logical, whether to account for time effect. Default value is TRUE. |
| model | character, indicates the model used for estimation, can be "full", "slm", "sem", "sltl". See Details. |
| th_type | character, "row" or "col". Indicates whether the threshold is applied to the columns or the rows of the weight matrix. Default value is "row". |
| ini_val | vector msdpd object. A length 4 vector of the initial values of lambda1, lambda2, lambda3, rho or an msdpd object that contain the non-threshold estimation result. If unsupplied msdpd() will be called. |
| rcpp | logical, whether to use the rcpp implementation to calculate the score function. Default value is TRUE. |
| cma_pop_multi | integer, multiplier for the population size used in CMA-ES. Default value is 1. |

## Details

Estimating threshold spatial dynamic panel data model with extended Yang(2018)'s M-estimator

$$y_{ti} = \mu_i + \alpha_t + x_{ti}\beta_q + \rho_q y_{t-1,i} + \lambda_{1q}\sum_{j=1}^{n} w_{1,ij}y_{tj} \qquad + \lambda_{2q}\sum_{j=1}^{n} w_{2,ij}y_{t-1,i} + u_{ti}, u_{ti} = \lambda_{3q}\sum_{j=1}^{n} w_{3,ij}u_{tj} + v_{ti}, i = 1, \ldots, n, t$$

The minimum number of time-periods is 4. Make sure the rows and columns of w1, w2, and w3 are lined up with the regional index. Sub-models can be specified by argument "model"

- "full" Full model
- "slm" $\lambda_{2q} = \lambda_{3q} = 0$
- "sem" $\lambda_{1q} = \lambda_{2q} = 0$
- "sltl" $\lambda_{3q} = 0$

Some suggestions when the optimizer fails:

- Increase max_try
- Increase cma_pop_multi
- try a different submodel

## Value

A list of estimation results of S3 class "msdpdth"

- "coefficient" list, coefficients and standard errors
- "model" character, model used for estimation

- "vc_mat" matrix, variance-covariance matrix
- "hes_mat" matrix, optional, Hessian matrix
- "gamma_mat" matrix, optional, Gamma matrix
- "residual" numeric, optional, residuals

## References

Wu, J and Matsuda, Y. (2021). A threshold extension of spatial dynamic panel model with fixed effects. Journal of Spatial Econometrics 2,3

## Examples

```
data(data_th, data_w)
result <- msdpdth(y = data_th$y, x = data_th$x, w1 = data_w, th = data_th$th)
```

---

`print.msdpd` *Print method for msdpd class*

---

## Description

Print method for msdpd class

## Usage

```
## S3 method for class 'msdpd'
print(x, ...)
```

## Arguments

| | |
|---|---|
| `x` | msdpd class |
| `...` | other parameters |

## Details

Print method for msdpd class

## Value

A data.frame containing the coefficients and the corresponding standard error.

## Examples

```
data(data_n, data_nw)
result <- msdpd(y = data_n$y, x = data_n$x, w1 = data_nw)
result
```

## print.msdpdth *Print method for msdpdth class*

### Description

Print method for msdpdth class

### Usage

```
## S3 method for class 'msdpdth'
print(x, ...)
```

### Arguments

| | |
|---|---|
| x | msdpdth class |
| ... | other parameters |

### Details

Print method for msdpdth class

### Value

A data.frame containing the coefficients and the corresponding standard error.

### Examples

```
data(data_th, data_w)
result <- msdpdth(y = data_th$y, x = data_th$x, w1 = data_w, th = data_th$th)
result
```

## wald_test *Wald test for threshold spatial dynamic panel data model*

### Description

Wald test for threshold spatial dynamic panel data model

### Usage

```
wald_test(th_res)
```

### Arguments

| | |
|---|---|
| th_res | msdpdth class, generated by function msdpdth() |

## Details

Two sided Wald test for testing whether two estimated parameters for each group are equal

- "h_0" $\theta_1 = \theta_2$
- "h_1" $\theta_1 \neq \theta_2$

## Value

A list of p-values for each parameter.

## Examples

```
data(data_th, data_w)
result <- msdpdth(y = data_th$y, x = data_th$x, w1 = data_w, th = data_th$th)
wald_test(result)
```

# Index

∗ **datasets**
data_n, 2
data_nw, 2
data_th, 3
data_w, 3
∗ **models**
sdpdth-package, 2

data_n, 2
data_nw, 2
data_th, 3
data_w, 3

msdpd, 3
msdpdth, 6

print.msdpd, 8
print.msdpdth, 9

sdpdth-package, 2

wald_test, 9