Package ‘DRDID’

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DRDID-package .................................................. 2
drdid .......................................................... 3
drdid_imp_panel ............................................... 6
ndid_imp_rc .................................................. 8
ndid_imp_rc1 .................................................. 10
drdid_panel .................................................. 12
drdid ......................................................... 14
drdid_rc ...................................................... 16
ipwdid ........................................................ 18
ipw_did_panel ................................................ 20
ipw_did_rc .................................................. 22
nsw .......................................................... 24
nsw_long ..................................................... 25
ordid ........................................................ 26
reg_did_panel ................................................ 28
reg_did_rc .................................................. 30
sim_rc ....................................................... 32
std_ipw_did_panel .......................................... 33
std_ipw_did_rc ............................................... 34
twfe_did_panel ............................................ 36
twfe_did_rc ................................................. 38

Index ......................................................... 40

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DRDID-package

Doubly robust difference-in-differences estimators

Description

The DRDID package implements different estimators for the average treatment effect on the treated in difference-in-differences (DID) setups where the parallel trends assumption holds after you condition on a vector of pre-treatment covariates. The main estimators implemented here are the locally efficient, doubly-robust DID estimators proposed by Sant’Anna and Zhao (2020) <https://arxiv.org/abs/1812.01723>. A number of other DID estimators discussed in Sant’Anna and Zhao (2020) are also implemented.

References

drdid is used to compute the locally efficient doubly robust estimators for the ATT in difference-in-differences (DiD) setups. It can be used with panel or stationary repeated cross section data. Data should be store in "long" format.

Usage

```r
drdid(
yname,
tname,
idname,
dname,
xformla = NULL,
data,
panel = TRUE,
estMethod = c("imp", "trad"),
weightsname = NULL,
boot = FALSE,
boot.type = c("weighted", "multiplier"),
nboot = 999,
inffunc = FALSE)
```

Arguments

- **yname**: The name of the outcome variable.
- **tname**: The name of the column containing the time periods.
- **idname**: The name of the column containing the unit id name.
- **dname**: The name of the column containing the treatment group (=1 if observation is treated in the post-treatment, =0 otherwise)
- **xformla**: A formula for the covariates to include in the model. It should be of the form \( \sim X1 + X2 \) (intercept should not be listed as it is always automatically included). Default is NULL which is equivalent to xformla=\(~1\).
- **data**: The name of the data.frame that contains the data.
- **panel**: Whether or not the data is a panel dataset. The panel dataset should be provided in long format – that is, where each row corresponds to a unit observed at a particular point in time. The default is TRUE. Whens panel = TRUE, the variable idname must be set. When panel = FALSE, the data is treated as stationary repeated cross sections.
estMethod: The method to estimate the nuisance parameters. The default is "imp" which uses weighted least squares to estimate the outcome regressions and inverse probability tilting to estimate the propensity score, leading to the improved locally efficient DR DID estimator proposed by Sant'Anna and Zhao (2020). The other alternative is "trad", which then uses OLS to estimate outcome regressions and maximum likelihood to estimate propensity score. This leads to the "traditional" locally efficient DR DID estimator proposed by Sant'Anna and Zhao (2020).

weightsname: The name of the column containing the sampling weights. If NULL, then every observation has the same weights.

boot: Logical argument to whether bootstrap should be used for inference. Default is FALSE and analytical standard errors are reported.

boot.type: Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot: Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc: Logical argument to whether influence function should be returned. Default is FALSE.

Details

When panel data are available (panel = TRUE), the drdid function implements the locally efficient doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.1) in Sant'Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of a linear regression model for the outcome evolution among the comparison units.

When only stationary repeated cross-section data are available (panel = FALSE), the drdid function implements the locally efficient doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.4) in Sant'Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of (separate) linear regression models for the outcome of both treated and comparison units, in both pre and post-treatment periods.

When one sets estMethod = "imp" (the default), the nuisance parameters (propensity score and outcome regression parameters) are estimated using the methods described in Sections 3.1 and 3.2 of Sant'Anna and Zhao (2020). In short, the propensity score parameters are estimated using the inverse probability tilting estimator proposed by Graham, Pinto and Pinto (2012), and the outcome regression coefficients are estimated using weighted least squares, where the weights depend on the propensity score estimates; see Sant'Anna and Zhao (2020) for details.

When one sets estMethod = "trad", the propensity score parameters are estimated using maximum likelihood, and the outcome regression coefficients are estimated using ordinary least squares.

The main advantage of using estMethod = "imp" is that the resulting estimator is not only locally efficient and doubly robust for the ATT, but it is also doubly robust for inference; see Sant'Anna and Zhao (2020) for details.

Value

A list containing the following components:
ATT  The DR DID point estimate
se  The DR DID standard error
uci Estimate of the upper bound of a 95% CI for the ATT
lci Estimate of the lower bound of a 95% CI for the ATT
boots All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
att.inf.func Estimate of the influence function. Default is NULL
ps.flag Convergence Flag for the propensity score estimation (only active if estMethod = "imp"). =0 if trust algorithm converged, =1 if IPT (original) algorithm converged (in case it was used), =2 if GLM logit estimator was used (i.e., if both trust and IPT did not converged).
call.param The matched call.
argu Some arguments used in the call (panel, estMethod, boot, boot.type, nboot, type="dr")

References


Examples

# -----------------------------------------------
# Panel data case
# -----------------------------------------------
# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw_long, nsw_long$treated == 0 | nsw_long$sample == 2)
# -----------------------------------------------
# Implement improved DR locally efficient DID with panel data
drdid(yname="re", tname = "year", idname = "id", dname = "experimental",
       xformla= ~ age+ educ+ black+ married+ nodegree+ hisp+ re74,
       data = eval_lalonde_cps, panel = TRUE)
#Implement "traditional" DR locally efficient DID with panel data
drdid(yname="re", tname = "year", idname = "id", dname = "experimental",
       xformla= ~ age+ educ+ black+ married+ nodegree+ hisp+ re74,
       data = eval_lalonde_cps, panel = TRUE, estMethod = "trad")

# -----------------------------------------------
# Repeated cross section case
# -----------------------------------------------
# use the simulated data provided in the package
#Implement "improved" DR locally efficient DID with repeated cross-section data
drdid(yname="y", tname = "post", idname = "id", dname = "d",
       xformla= ~ x1 + x2 + x3 + x4,
drdid_imp_panel

Improved locally efficient doubly robust DiD estimator for the ATT, with panel data

Description

drdid_imp_panel is used to compute the locally efficient doubly robust estimators for the ATT in difference-in-differences (DiD) setups with panel data. The resulting estimator is also doubly robust for inference; see Section 3.1 of Sant’Anna and Zhao (2020).

Usage

```r
drdid_imp_panel(
  y1,
  y0,
  D,
  covariates,
  i.weights = NULL,
  boot = FALSE,
  boot.type = "weighted",
  nboot = NULL,
  inffunc = FALSE
)
```

Arguments

- `y1`: An n x 1 vector of outcomes from the post-treatment period.
- `y0`: An n x 1 vector of outcomes from the pre-treatment period.
- `D`: An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
- `covariates`: An n x k matrix of covariates to be used in the propensity score and regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.
- `i.weights`: An n x 1 vector of weights to be used. If NULL, then every observation has the same weights.
- `boot`: Logical argument to whether bootstrap should be used for inference. Default is FALSE.
- `boot.type`: Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".
The `drdid_imp_panel` function implements the locally efficient doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.1) in Sant’Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of a linear regression model for the outcome evolution among the comparison units.

The nuisance parameters (propensity score and outcome regression parameters) are estimated using the methods described in Sections 3.1 of Sant’Anna and Zhao (2020). In short, the propensity score parameters are estimated using the inverse probability tilting estimator proposed by Graham, Pinto and Pinto (2012), and the outcome regression coefficients are estimated using weighted least squares, where the weights depend on the propensity score estimates; see Sant’Anna and Zhao (2020) for details.

The resulting estimator is not only locally efficient and doubly robust for the ATT, but it is also doubly robust for inference; see Sant’Anna and Zhao (2020) for details.

Value

A list containing the following components:

- `ATT` The DID point estimate.
- `se` The DID standard error.
- `uci` The upper bound of the 95% CI for the ATT.
- `lci` The lower bound of the 95% CI for the ATT.
- `boots` All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL.
- `ps.flag` Convergence Flag for the propensity score estimation: =0 if trust algorithm converged, =1 if IPW algorithm converged (in case it was used), =2 if GLM logit estimator was used (i.e., if both trust and IPT did not converged).
- `att.inf.func` Estimate of the influence function. Default is NULL.
- `call.param` The matched call.
- `argu` Some arguments used (explicitly or not) in the call (panel = TRUE, estMethod = "imp", boot, boot.type, nboot, type=“dr”)
drdid_imp_rc

Examples

# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw, nsw$treated == 0 | nsw$sample == 2)
# Select some covariates
covX = as.matrix(cbind(eval_lalonde_cps$age, eval_lalonde_cps$educ,
   eval_lalonde_cps$black, eval_lalonde_cps$married,
   eval_lalonde_cps$nodegree, eval_lalonde_cps$hisp,
   eval_lalonde_cps$re74))

# Implement improved DR locally efficient DID with panel data
drdid_imp_panel(y1 = eval_lalonde_cps$re78, y0 = eval_lalonde_cps$re75,
   D = eval_lalonde_cps$experimental,
   covariates = covX)

Description

drdid_imp_rc is used to compute the locally efficient doubly robust estimators for the ATT in difference-in-differences (DiD) setups with stationary repeated cross-sectional data. The resulting estimator is also doubly robust for inference; see Section 3.2 of Sant’Anna and Zhao (2020).

Usage

drdid_imp_rc(
  y,
  post,
  D,
  covariates,
  i.weights = NULL,
  boot = FALSE,
  boot.type = "weighted",
  nboot = NULL,
  inffunc = FALSE
)

Arguments

y An n x 1 vector of outcomes from the both pre and post-treatment periods.

post An n x 1 vector of Post-Treatment dummies (post = 1 if observation belongs to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)

D An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise.)
drdid_imp_rc

covariates: An \(n \times k\) matrix of covariates to be used in the propensity score and regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.

i.weights: An \(n \times 1\) vector of weights to be used. If NULL, then every observation has the same weights.

boot: Logical argument to whether bootstrap should be used for inference. Default is FALSE.

boot.type: Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot: Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc: Logical argument to whether influence function should be returned. Default is FALSE.

Details

The `drdid_imp_rc` function implements the locally efficient doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.4) in Sant'Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of (separate) linear regression models for the outcome of both treated and comparison units, in both pre and post-treatment periods.

The nuisance parameters (propensity score and outcome regression parameters) are estimated using the methods described in Sections 3.2 of Sant'Anna and Zhao (2020). In short, the propensity score parameters are estimated using the inverse probability tilting estimator proposed by Graham, Pinto and Pinto (2012), and the outcome regression coefficients are estimated using weighted least squares, where the weights depend on the propensity score estimates; see Sant'Anna and Zhao (2020) for details.

The resulting estimator is not only locally efficient and doubly robust for the ATT, but it is also doubly robust for inference; see Sant'Anna and Zhao (2020) for details.

Value

A list containing the following components:

- **ATT**: The DR DID point estimate
- **se**: The DR DID standard error
- **uci**: Estimate of the upper bound of a 95% CI for the ATT
- **lci**: Estimate of the lower bound of a 95% CI for the ATT
- **boots**: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL.
- **ps.flag**: Convergence Flag for the propensity score estimation: =0 if trust algorithm converged, =1 if IPW algorithm converged (in case it was used), =2 if GLM logit estimator was used (i.e., if both trust and IPT did not converged).
- **att.inf.func**: Estimate of the influence function. Default is NULL.
- **call.param**: The matched call.
- **argu**: Some arguments used (explicitly or not) in the call (panel = FALSE, estMethod = "imp", boot, boot.type, nboot, type="dr")
References


Examples

# use the simulated data
covX = as.matrix(sim_rc[,5:8])
# Implement the improved, locally efficient DR DID estimator
drdid_imp_rc(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d, covariates= covX)

Usage

```
drdid_imp_rc1(y, post, D, covariates, i.weights = NULL, boot = FALSE, boot.type = "weighted", nboot = NULL, inffunc = FALSE)
```

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>y</code></td>
<td>An n x 1 vector of outcomes from the both pre and post-treatment periods.</td>
</tr>
<tr>
<td><code>post</code></td>
<td>An n x 1 vector of Post-Treatment dummies (post = 1 if observation belongs to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)</td>
</tr>
</tbody>
</table>
The `drdid_imp_rc1` function implements the doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.3) in Sant’Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of (separate) linear regression models for the outcome among the comparison units in both pre and post-treatment time periods. Importantly, this estimator is not locally efficient for the ATT.

The nuisance parameters (propensity score and outcome regression parameters) are estimated using the methods described in Sections 3.2 of Sant’Anna and Zhao (2020). In short, the propensity score parameters are estimated using the inverse probability tilting estimator proposed by Graham, Pinto and Pinto (2012), and the outcome regression coefficients are estimated using weighted least squares, where the weights depend on the propensity score estimates; see Sant’Anna and Zhao (2020) for details.

The resulting estimator is not only doubly robust for the ATT, but it is also doubly robust for inference. However, we stress that it is not locally efficient; see Sant’Anna and Zhao (2020) for details.

**Details**

The `drdid_imp_rc1` function implements the doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.3) in Sant’Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of (separate) linear regression models for the outcome among the comparison units in both pre and post-treatment time periods. Importantly, this estimator is not locally efficient for the ATT.

The nuisance parameters (propensity score and outcome regression parameters) are estimated using the methods described in Sections 3.2 of Sant’Anna and Zhao (2020). In short, the propensity score parameters are estimated using the inverse probability tilting estimator proposed by Graham, Pinto and Pinto (2012), and the outcome regression coefficients are estimated using weighted least squares, where the weights depend on the propensity score estimates; see Sant’Anna and Zhao (2020) for details.

The resulting estimator is not only doubly robust for the ATT, but it is also doubly robust for inference. However, we stress that it is not locally efficient; see Sant’Anna and Zhao (2020) for details.

**Value**

A list containing the following components:

- **ATT** The DR DID point estimate
- **se** The DR DID standard error
- **uci** Estimate of the upper bound of a 95% CI for the ATT
- **lci** Estimate of the lower bound of a 95% CI for the ATT
- **boots** All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
- **ps.flag** Convergence Flag for the propensity score estimation: =0 if `trust` algorithm converged, =1 if IPW algorithm converged (in case it was used), =2 if GLM logit estimator was used (i.e., if both `trust` and IPT did not converged).
The drdid_panel function is used to compute the locally efficient doubly robust estimators for the ATT in difference-in-differences (DiD) setups with panel data.

Usage

```r
drdid_panel(
y1,  
y0,  
D,  
covariates,  
i.weights = NULL,  
boot = FALSE,  
boot.type = "weighted",  
nboot = NULL,  
inffunc = FALSE
)
```

References


Arguments

y1: An $n \times 1$ vector of outcomes from the post-treatment period.

y0: An $n \times 1$ vector of outcomes from the pre-treatment period.

D: An $n \times 1$ vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).

covariates: An $n \times k$ matrix of covariates to be used in the propensity score and regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.

i.weights: An $n \times 1$ vector of weights to be used. If NULL, then every observation has the same weights.

boot: Logical argument to whether bootstrap should be used for inference. Default is FALSE.

boot.type: Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot: Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc: Logical argument to whether influence function should be returned. Default is FALSE.

Details

The `drdid_panel` function implements the locally efficient doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.1) in Sant’Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of a linear regression model for the outcome evolution among the comparison units.

The propensity score parameters are estimated using maximum likelihood, and the outcome regression coefficients are estimated using ordinary least squares.

Value

A list containing the following components:

ATT: The DR DID point estimate.

se: The DR DID standard error.

uci: Estimate of the upper bound of a 95% CI for the ATT.

lci: Estimate of the lower bound of a 95% CI for the ATT.

boots: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL.

att.inf.func: Estimate of the influence function. Default is NULL.

call.param: The matched call.

argu: Some arguments used (explicitly or not) in the call (panel = TRUE, estMethod = "trad", boot, boot.type, nboot, type="dr")
References


Examples

# Form the Lalonde sample with CPS comparison group (data in wide format)
eval_lalonde_cps <- subset(nsw, nsw$treated == 0 | nsw$sample == 2)
# Select some covariates
covX = as.matrix(cbind(eval_lalonde_cps$age, eval_lalonde_cps$educ,
                      eval_lalonde_cps$black, eval_lalonde_cps$married,
                      eval_lalonde_cps$nodegree, eval_lalonde_cps$hisp,
                      eval_lalonde_cps$re74))

# Implement traditional DR locally efficient DID with panel data
drdid_panel(y1 = eval_lalonde_cps$re78, y0 = eval_lalonde_cps$re75,
             D = eval_lalonde_cps$experimental,
             covariates = covX)

---

drdid_rc

Locally efficient doubly robust DiD estimator for the ATT, with repeated cross-section data

Description

drdid_rc is used to compute the locally efficient doubly robust estimators for the ATT in difference-in-differences (DiD) setups with stationary repeated cross-sectional data.

Usage

drdid_rc(
y, post, D, covariates, i.weights = NULL, boot = FALSE, boot.type = "weighted", nboot = NULL, inffunc = FALSE
)

Arguments

y An n x 1 vector of outcomes from the both pre and post-treatment periods.
\textbf{drdid.rc}  

- **post**: An \( n \times 1 \) vector of Post-Treatment dummies (\( \text{post} = 1 \) if observation belongs to post-treatment period, and \( \text{post} = 0 \) if observation belongs to pre-treatment period.)

- **D**: An \( n \times 1 \) vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).

- **covariates**: An \( n \times k \) matrix of covariates to be used in the propensity score and regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.

- **i.weights**: An \( n \times 1 \) vector of weights to be used. If NULL, then every observation has the same weights.

- **boot**: Logical argument to whether bootstrap should be used for inference. Default is FALSE.

- **boot.type**: Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

- **nboot**: Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

- **inffunc**: Logical argument to whether influence function should be returned. Default is FALSE.

\textbf{Details}

The \texttt{drdid.rc} function implements the locally efficient doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.4) in Sant’Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of (separate) linear regression models for the outcome of both treated and comparison units, in both pre and post-treatment periods.

The propensity score parameters are estimated using maximum likelihood, and the outcome regression coefficients are estimated using ordinary least squares; see Sant’Anna and Zhao (2020) for details.

\textbf{Value}

A list containing the following components:

- **ATT**: The TR-DR DID point estimate
- **se**: The TR-DR DID standard error
- **uci**: Estimate of the upper bound of a 95\% CI for the ATT
- **lci**: Estimate of the lower bound of a 95\% CI for the ATT
- **boots**: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL.
- **att.inf.func**: Estimate of the influence function. Default is NULL.
- **call.param**: The matched call.
- **argu**: Some arguments used (explicitly or not) in the call (panel = TRUE, estMethod = "trad", boot, boot.type, nboot, type="dr")
References


Examples

```r
# use the simulated data provided in the package
covX = as.matrix(sim_rc[,5:8])
# Implement the 'traditional' locally efficient DR DID estimator
drdid_rc(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d, covariates= covX)
```

---

drdid_rc1

**Doubly robust DiD estimator for the ATT, with repeated cross-section data**

Description

`drdid_rc1` is used to compute the doubly robust estimators for the ATT in difference-in-differences (DiD) setups with stationary repeated cross-sectional data. The resulting estimator is not locally efficient; see Section 3.2 of Sant’Anna and Zhao (2020).

Usage

```r
drdid_rc1(
  y,
  post,
  D,
  covariates,
  i.weights = NULL,
  boot = FALSE,
  boot.type = "weighted",
  nboot = NULL,
  inffunc = FALSE
)
```

Arguments

- **y**: An n x 1 vector of outcomes from the both pre and post-treatment periods.
- **post**: An n x 1 vector of Post-Treatment dummies (post = 1 if observation belongs to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)
- **D**: An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
- **covariates**: An n x k matrix of covariates to be used in the propensity score and regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.
i.weights

An \( n \times 1 \) vector of weights to be used. If NULL, then every observation has the same weights.

boot

Logical argument to whether bootstrap should be used for inference. Default is FALSE.

boot.type

Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot

Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc

Logical argument to whether influence function should be returned. Default is FALSE.

Details

The \texttt{drdid_rc1} function implements the doubly robust difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (3.3) in Sant’Anna and Zhao (2020). This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and of (separate) linear regression models for the outcome among the comparison units in both pre and post-treatment time periods. Importantly, this estimator is not locally efficient for the ATT.

The propensity score parameters are estimated using maximum likelihood, and the outcome regression coefficients are estimated using ordinary least squares.

The resulting estimator is not not locally efficient; see Sant’Anna and Zhao (2020) for details.

Value

A list containing the following components:

- **ATT**: The DR DID point estimate
- **se**: The DR DID standard error
- **uci**: Estimate of the upper bound of a 95\% CI for the ATT
- **lci**: Estimate of the lower bound of a 95\% CI for the ATT
- **boots**: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
- **att.inf.func**: Estimate of the influence function. Default is NULL
- **call.param**: The matched call.
- **argu**: Some arguments used (explicitly or not) in the call (panel = FALSE, estMethod = "trad2", boot, boot.type, nboot, type=\"dr\")

References

Examples

```r
# use the simulated data provided in the package
covX = as.matrix(sim_rc[,5:8])
# Implement the 'traditional' DR DID estimator (not locally efficient!)
drdid_rc1(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d,
covariates= covX)
```

`ipwdid` *Inverse probability weighted DiD estimators for the ATT*

Description

`ipwdid` computes the inverse probability weighted estimators for the average treatment effect on the treated in difference-in-differences (DiD) setups. It can be used with panel or stationary repeated cross-sectional data, with or without normalized (stabilized) weights. See Abadie (2005) and Sant’Anna and Zhao (2020) for details.

Usage

```r
ipwdid(
yname, 
tname, 
idname, 
dname, 
xformla = NULL, 
data, 
panel = TRUE, 
normalized = TRUE, 
weightsname = NULL, 
boot = FALSE, 
boot.type = c("weighted", "multiplier"), 
nboot = 999, 
inffunc = FALSE
)
```

Arguments

- **yname**  
  The name of the outcome variable.
- **tname**  
  The name of the column containing the time periods.
- **idname**  
  The name of the column containing the unit id name.
- **dname**  
  The name of the column containing the treatment group (=1 if observation is treated in the post-treatment, =0 otherwise)
- **xformla**  
  A formula for the covariates to include in the model. It should be of the form \( \sim X_1 + X_2 \) (intercept should not be listed as it is always automatically included). Default is NULL which is equivalent to `xformla=\(~1.`
The `ipwdid` function implements the inverse probability weighted (IPW) difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) proposed by Abadie (2005) (normalized = FALSE) or Hajek-type version defined in equations (4.1) and (4.2) in Sant’Anna and Zhao (2020), when either panel data or stationary repeated cross-sectional data are available. This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and the propensity score parameters are estimated via maximum likelihood.

The_ipwdid function implements the inverse probability weighted (IPW) difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) proposed by Abadie (2005) (normalized = FALSE) or Hajek-type version defined in equations (4.1) and (4.2) in Sant’Anna and Zhao (2020), when either panel data or stationary repeated cross-sectional data are available. This estimator makes use of a logistic propensity score model for the probability of being in the treated group, and the propensity score parameters are estimated via maximum likelihood.

**Value**

A list containing the following components:

- **ATT**: The IPW DID point estimate
- **se**: The IPW DID standard error
- **uci**: Estimate of the upper bound of a 95% CI for the ATT
- **lci**: Estimate of the lower bound of a 95% CI for the ATT
- **boots**: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
- **att.inf.func**: Estimate of the influence function. Default is NULL
- **call.param**: The matched call.
- **argu**: Some arguments used in the call (panel, normalized, boot, boot.type, nboot, type=="ipw")
References


Examples

```r
# -----------------------------------------------
# Panel data case
# -----------------------------------------------
# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw_long, nsw_long$treated == 0 | nsw_long$sample == 2)

# Implement IPW DID with panel data (normalized weights)
ipwdid(yname="re", tname = "year", idname = "id", dname = "experimental",
xformula= ~ age+ educ+ black+ married+ nodegree+ hisp+ re74,
data = eval_lalonde_cps, panel = TRUE)

# -----------------------------------------------
# Repeated cross section case
# -----------------------------------------------
# use the simulated data provided in the package
#Implement IPW DID with repeated cross-section data (normalized weights)
# use Bootstrap to make inference with 199 bootstrap draws (just for illustration)
ipwdid(yname="y", tname = "post", idname = "id", dname = "d",
xformula= ~ x1 + x2 + x3 + x4,
data = sim_rc, panel = FALSE,
boot = TRUE, nboot = 199)
```

Description

`ipw_did_panel` is used to compute inverse probability weighted (IPW) estimators for the ATT in difference-in-differences (DiD) setups with panel data. IPW weights are not normalized to sum up to one, that is, the estimator is of the Horwitz-Thompson type.

Usage

```r
ipw_did_panel(
  y1,
y0,
D,
covariates,
i.weights = NULL,
```
```r
boot = FALSE,
boot.type = "weighted",
nboot = NULL,
inffunc = FALSE
)
```

**Arguments**

- `y1` An \( n \times 1 \) vector of outcomes from the post-treatment period.
- `y0` An \( n \times 1 \) vector of outcomes from the pre-treatment period.
- `D` An \( n \times 1 \) vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
- `covariates` An \( n \times k \) matrix of covariates to be used in the propensity score estimation. If `covariates = NULL`, this leads to an unconditional DID estimator.
- `i.weights` An \( n \times 1 \) vector of weights to be used. If `NULL`, then every observation has the same weights.
- `boot` Logical argument to whether bootstrap should be used for inference. Default is `FALSE`.
- `boot.type` Type of bootstrap to be performed (not relevant if `boot = FALSE`). Options are "weighted" and "multiplier". If `boot = TRUE`, default is "weighted".
- `nboot` Number of bootstrap repetitions (not relevant if `boot = FALSE`). Default is 999.
- `inffunc` Logical argument to whether influence function should be returned. Default is `FALSE`.

**Value**

A list containing the following components:

- `ATT` The IPW DID point estimate.
- `se` The IPW DID standard error.
- `uci` Estimate of the upper bound of a 95% CI for the ATT.
- `lci` Estimate of the lower bound of a 95% CI for the ATT.
- `boots` All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is `NULL`.
- `att.inf.func` Estimate of the influence function. Default is `NULL`.
- `call.param` The matched call.
- `argu` Some arguments used (explicitly or not) in the call (panel = TRUE, normalized = FALSE, boot, boot.type, nboot, type="ipw")

**References**


Examples

# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw, nsw$treated == 0 | nsw$sample == 2)
# Select some covariates
covX = as.matrix(cbind(eval_lalonde_cps$age, eval_lalonde_cps$educ,
  eval_lalonde_cps$black, eval_lalonde_cps$married,
  eval_lalonde_cps$nodegree, eval_lalonde_cps$hisp,
  eval_lalonde_cps$re74))
# Implement (unnormalized) IPW DID with panel data
ipw_did_panel(y1 = eval_lalonde_cps$re78, y0 = eval_lalonde_cps$re75,
  D = eval_lalonde_cps$experimental,
  covariates = covX)

ipw_did_rc
Inverse probability weighted DiD estimator, with repeated cross-section data

Description

ipw_did_rc is used to compute inverse probability weighted (IPW) estimators for the ATT in difference-in-differences (DiD) setups with stationary cross-sectional data. IPW weights are not normalized to sum up to one, that is, the estimator is of the Horwitz-Thompson type.

Usage

ipw_did_rc(
  y,
  post,
  D,
  covariates,
  i.weights = NULL,
  boot = FALSE,
  boot.type = "weighted",
  nboot = NULL,
  inffunc = FALSE
)

Arguments

y  An n x 1 vector of outcomes from the both pre and post-treatment periods.
post  An n x 1 vector of Post-Treatment dummies (post = 1 if observation belongs to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)
D  An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
**covariates**  
An \( n \times k \) matrix of covariates to be used in the propensity score estimation. If covariates = NULL, this leads to an unconditional DID estimator.

**i.weights**  
An \( n \times 1 \) vector of weights to be used. If NULL, then every observation has the same weights.

**boot**  
Logical argument to whether bootstrap should be used for inference. Default is FALSE.

**boot.type**  
Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

**nboot**  
Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

**inffunc**  
Logical argument to whether influence function should be returned. Default is FALSE.

**Value**

A list containing the following components:

- **ATT**  
The IPW DID point estimate.

- **se**  
The IPW DID standard error

- **uci**  
Estimate of the upper bound of a 95% CI for the ATT

- **lci**  
Estimate of the lower bound of a 95% CI for the ATT

- **boots**  
All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL

- **att.inf.func**  
Estimate of the influence function. Default is NULL

- **call.param**  
The matched call.

- **argu**  
Some arguments used (explicitly or not) in the call (panel = FALSE, normalized = FALSE, boot, boot.type, nboot, type="ipw")

**References**


**Examples**

# use the simulated data provided in the package
covX = as.matrix(sim_rc[,5:8])
# Implement unnormalized IPW DID estimator
ipw_did_rc(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d, covariates= covX)
### Description

*nsw* contains all the subsamples of from the National Supported Work (NSW) Demonstration analyzed used by Smith and Todd (2005) in their paper "Does matching overcome LaLonde’s critique of nonexperimental estimators?".

### Usage

*nsw*

### Format

A data frame in "wide" format with 19204 observations on the following and 14 variables:

- **treated**: an indicator variable for treatment status. Missing if not part of the NSW experimental sample.
- **age**: age in years.
- **educ**: years of schooling.
- **black**: indicator variable for blacks.
- **married**: indicator variable for marital status.
- **nodegree**: indicator variable for high school diploma.
- **dwincl**: indicator variable for inclusion in Dehejia and Wahba sample. Missing if not part of the experimental sample.
- **re74**: real earnings in 1974 (pre-treatment).
- **re75**: real earnings in 1975 (pre-treatment).
- **re78**: real earnings in 1978 (post-treatment).
- **hisp**: indicator variable for Hispanics.
- **early_ra**: indicator variable for inclusion in the early random assignment sample in Smith and Todd (2005). Missing if not part of the experimental sample.
- **sample**: 1 if NSW (experimental sample), 2 if CPS comparison group, 3 if PSID comparison group.
- **experimental**: 1 if in experimental sample, 0 otherwise.

### Source


### References


Description

*nsw_long* is the same dataset as *nsw* but in a long format.

Usage

*nsw_long*

Format

A data frame in "long" format with 38408 observations on the following and 15 variables:

- **id**  unique identifier for each cross-sectional unit (worker).
- **year**  year. 1975 is the pre-treatment and 1978 is the post-treatment
- **treated**  an indicator variable for treatment status. Missing if not part of the NSW experimental sample.
- **age**  age in years.
- **educ**  years of schooling.
- **black**  indicator variable for blacks.
- **married**  indicator variable for marital status.
- **nnodegree**  indicator variable for high school diploma.
- **dwincl**  indicator variable for inclusion in Dehejia and Wahba sample. Missing if not part of the experimental sample
- **re74**  real earnings in 1974 (pre-treatment).
- **hisp**  indicator variable for Hispanics.
- **early_ra**  indicator variable for inclusion in the early random assignment sample in Smith and Todd (2005). Missing if not part of the experimental sample
- **sample**  1 if NSW (experimental sample), 2 if CPS comparison group, 3 if PSID comparison group.
- **re**  real earnings (outcome of interest).
- **experimental**  1 if in experimental sample, 0 otherwise.

Source


References


Description

`ordid` computes the outcome regressions estimators for the average treatment effect on the treated in difference-in-differences (DiD) setups. It can be used with panel or repeated cross section data. See Sant’Anna and Zhao (2020) for details.

Usage

```r
ordid(
  yname,  # The name of the outcome variable.
  tname,  # The name of the column containing the time periods.
  idname,  # The name of the column containing the unit id name.
  dname,  # The name of the column containing the treatment group (=1 if observation is treated in the post-treatment, =0 otherwise)
  xformula = NULL,  # A formula for the covariates to include in the model. It should be of the form ~ X1 + X2. (intercept should not be listed as it is always automatically included). Default is NULL which is equivalent to xformula=~1.
  data,  # The name of the data.frame that contains the data.
  panel = TRUE,  # Whether or not the data is a panel dataset. The panel dataset should be provided in long format – that is, where each row corresponds to a unit observed at a particular point in time. The default is TRUE. When panel = TRUE, the variable idname must be set. When panel = FALSE, the data is treated as stationary repeated cross sections.
  weightsname = NULL,  # The name of the column containing the sampling weights. If NULL, then every observation has the same weights.
  boot = FALSE,  # Whether or not to use bootstrapping.
  boot.type = c("weighted", "multiplier"),  # Method of bootstrapping.
  nboot = 999)  # Number of bootstrap samples.
```

Arguments

- `yname`: The name of the outcome variable.
- `tname`: The name of the column containing the time periods.
- `idname`: The name of the column containing the unit id name.
- `dname`: The name of the column containing the treatment group (=1 if observation is treated in the post-treatment, =0 otherwise)
- `xformula`: A formula for the covariates to include in the model. It should be of the form ~ X1 + X2. (intercept should not be listed as it is always automatically included). Default is NULL which is equivalent to xformula=~1.
- `data`: The name of the data.frame that contains the data.
- `panel`: Whether or not the data is a panel dataset. The panel dataset should be provided in long format – that is, where each row corresponds to a unit observed at a particular point in time. The default is TRUE. When panel = TRUE, the variable idname must be set. When panel = FALSE, the data is treated as stationary repeated cross sections.
- `weightsname`: The name of the column containing the sampling weights. If NULL, then every observation has the same weights.
**boot** Logical argument to whether bootstrap should be used for inference. Default is FALSE and analytical standard errors are reported.

**boot.type** Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

**nboot** Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

**inffunc** Logical argument to whether influence function should be returned. Default is FALSE.

**Details**

The `ordid` function implements outcome regression difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (2.2) of Sant’Anna and Zhao (2020). The estimator follows the same spirit of the nonparametric estimators proposed by Heckman, Ichimura and Todd (1997), though here the the outcome regression models are assumed to be linear in covariates (parametric).

The nuisance parameters (outcome regression coefficients) are estimated via ordinary least squares.

**Value**

A list containing the following components:

- **ATT** The IPW DID point estimate
- **se** The IPW DID standard error
- **uci** Estimate of the upper bound of a 95% CI for the ATT
- **lci** Estimate of the lower bound of a 95% CI for the ATT
- **boots** All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
- **att.inf.func** Estimate of the influence function. Default is NULL
- **call.param** The matched call.
- **argu** Some arguments used in the call (panel, normalized, boot, boot.type, nboot, type="or")

**References**


**Examples**

```r
# -----------------------------------------------
# Panel data case
# -----------------------------------------------
# Form the Lalonde sample with CPS comparison group
```
eval_lalonde_cps <- subset(nsw_long, nsw_long$treated == 0 | nsw_long$sample == 2)

# Implement OR DID with panel data
ordid(yname="re", tname = "year", idname = "id", dname = "experimental",
     xformla= ~ age + educ + black + married + nnodegree + hisp + re74,
     data = eval_lalonde_cps, panel = TRUE)

# Repeated cross section case
# -----------------------------------------------
# use the simulated data provided in the package
# Implement OR DID with repeated cross-section data
# use Bootstrap to make inference with 199 bootstrap draws (just for illustration)
ordid(yname="y", tname = "post", idname = "id", dname = "d",
     xformla= ~ x1 + x2 + x3 + x4,
     data = sim_rc, panel = FALSE,
     boot = TRUE, nboot = 199)

---

**reg_did_panel**

*Outcome regression DiD estimator for the ATT, with panel data*

**Description**

`reg_did_panel` computes the outcome regressions estimators for the average treatment effect on the treated in difference-in-differences (DiD) setups with panel data.

**Usage**

```r
reg_did_panel(
    y1,
    y0,
    D,
    covariates,
    i.weights = NULL,
    boot = FALSE,
    boot.type = "weighted",
    nboot = NULL,
    inffunc = FALSE
)
```

**Arguments**

- `y1` An n x 1 vector of outcomes from the post-treatment period.
- `y0` An n x 1 vector of outcomes from the pre-treatment period.
- `D` An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
covariates An $n \times k$ matrix of covariates to be used in the regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.

i.weights An $n \times 1$ vector of weights to be used. If NULL, then every observation has the same weights.

boot Logical argument to whether bootstrap should be used for inference. Default is FALSE.

boot.type Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc Logical argument to whether influence function should be returned. Default is FALSE.

Details

The reg_did_panel function implements outcome regression difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (2.2) of Sant’Anna and Zhao (2020) when panel data are available. The estimator follows the same spirit of the non-parametric estimators proposed by Heckman, Ichimura and Todd (1997), though here the outcome regression models are assumed to be linear in covariates (parametric).

The nuisance parameters (outcome regression coefficients) are estimated via ordinary least squares.

Value

A list containing the following components:

ATT The Reg DID point estimate
se The Reg DID standard error
uci Estimate of the upper bound of a 95% CI for the ATT
lci Estimate of the lower bound of a 95% CI for the ATT
boots All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
att.inf.func Estimate of the influence function. Default is NULL
call.param The matched call.
argu Some arguments used (explicitly or not) in the call (panel = TRUE, boot, boot.type, nboot, type="or")

References


Examples

# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw, nsw$treated == 0 | nsw$sample == 2)
# Select some covariates
covX = as.matrix(cbind(eval_lalonde_cps$age, eval_lalonde_cps$educ,
    eval_lalonde_cps$black, eval_lalonde_cps$married,
    eval_lalonde_cps$nodegree, eval_lalonde_cps$hisp,
    eval_lalonde_cps$re74))
# Implement OR DID with panel data
reg_did_panel(y1 = eval_lalonde_cps$re78, y0 = eval_lalonde_cps$re75,
    D = eval_lalonde_cps$experimental,
    covariates = covX)

reg_did_rc  Outcome regression DiD estimator for the ATT, with repeated cross-section data

Description

reg_did_rc computes the outcome regressions estimators for the average treatment effect on the treated in difference-in-differences (DiD) setups with stationary repeated cross-sectional data.

Usage

reg_did_rc(
    y, post, D, covariates,
    i.weights = NULL, boot = FALSE, boot.type = "weighted",
    nboot = NULL, inffunc = FALSE)

Arguments

  y  An n x 1 vector of outcomes from the both pre and post-treatment periods.
  post  An n x 1 vector of Post-Treatment dummies (post = 1 if observation belongs to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)
  D  An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
  covariates  An n x k matrix of covariates to be used in the regression estimation. If covariates = NULL, this leads to an unconditional DID estimator.
i.weights  An n x 1 vector of weights to be used. If NULL, then every observation has the same weights.

boot  Logical argument to whether bootstrap should be used for inference. Default is FALSE.

boot.type  Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot  Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc  Logical argument to whether influence function should be returned. Default is FALSE.

Details

The `reg_did_rc` function implements outcome regression difference-in-differences (DID) estimator for the average treatment effect on the treated (ATT) defined in equation (2.2) of Sant’Anna and Zhao (2020) when stationary repeated cross-sectional data are available. The estimator follows the same spirit of the nonparametric estimators proposed by Heckman, Ichimura and Todd (1997), though here the the outcome regression models are assumed to be linear in covariates (parametric).

The nuisance parameters (outcome regression coefficients) are estimated via ordinary least squares.

Value

A list containing the following components:

ATT  The Reg DID point estimate

se  The Reg DID standard error

uci  Estimate of the upper bound of a 95% CI for the ATT

lci  Estimate of the lower bound of a 95% CI for the ATT

boots  All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL

att.inf.func  Estimate of the influence function. Default is NULL

call.param  The matched call.

argu  Some arguments used (explicitly or not) in the call (panel = FALSE, boot, boot.type, nboot, type="or")

References


Examples

```r
# use the simulated data provided in the package
covX = as.matrix(sim_rc[,5:8])
# Implement OR DID estimator
reg_did_rc(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d,
covariates= covX)
```

---

**sim_rc**

*Simulated repeated cross-section data*

Description

`sim_rc` contains a simulated dataset following the DGP1 in Sant’Anna and Zhao (2020).

Usage

`sim_rc`

Format

A data frame in "long" format with 1000 observations on the following and 8 variables:

- **id**: unique identifier for each cross-sectional unit.
- **post**: an indicator variable for post-treatment period (1 if post, 0 if pre treatment period).
- **y**: outcome of interest
- **d**: an indicator variable for treatment group. Equal to 1 if experience treatment in the post-treatment period; equal to 0 if never experience treatment.
- **x1**: Covariate z1 in Sant’Anna and Zhao(2020)
- **x2**: Covariate z2 in Sant’Anna and Zhao(2020)
- **x3**: Covariate z3 in Sant’Anna and Zhao(2020)
- **x4**: Covariate z4 in Sant’Anna and Zhao(2020)

Source

Sant’Anna and Zhao (2020)

References

**Description**

`std_ipw_did_panel` is used to compute inverse probability weighted (IPW) estimators for the ATT in difference-in-differences (DiD) setups with panel data. IPW weights are normalized to sum up to one, that is, the estimator is of the Hajek type.

**Usage**

```r
std_ipw_did_panel(
  y1,  
y0,  
D,  
covariates,  
i.weights = NULL,  
boot = FALSE,  
boot.type = "weighted",  
nboot = NULL,  
inffunc = FALSE
)
```

**Arguments**

- `y1` An n x 1 vector of outcomes from the post-treatment period.
- `y0` An n x 1 vector of outcomes from the pre-treatment period.
- `D` An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment, =0 otherwise).
- `covariates` An n x k matrix of covariates to be used in the propensity score estimation. If covariates = NULL, this leads to an unconditional DID estimator.
- `i.weights` An n x 1 vector of weights to be used. If NULL, then every observation has the same weights.
- `boot` Logical argument to whether bootstrap should be used for inference. Default is FALSE.
- `boot.type` Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".
- `nboot` Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.
- `inffunc` Logical argument to whether influence function should be returned. Default is FALSE.
std_ipw_did_rc

**Value**

A list containing the following components:

- **ATT**: The IPW DID point estimate.
- **se**: The IPW DID standard error
- **uci**: Estimate of the upper bound of a 95% CI for the ATT
- **lci**: Estimate of the lower bound of a 95% CI for the ATT
- **boots**: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL
- **att.inf.func**: Estimate of the influence function. Default is NULL
- **call.param**: The matched call.
- **argu**: Some arguments used (explicitly or not) in the call (panel = TRUE, normalized = TRUE, boot, boot.type, nboot, type="ipw")

**References**


**Examples**

```r
# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw, nsw$treated == 0 | nsw$sample == 2)
# Select some covariates
covX = as.matrix(cbind(eval_lalonde_cps$age, eval_lalonde_cps$educ,
eval_lalonde_cps$black, eval_lalonde_cps$married,
eval_lalonde_cps$nodegree, eval_lalonde_cps$hisp,
eval_lalonde_cps$re74))
# Implement normalized IPW DID with panel data
std_ipw_did_panel(y1 = eval_lalonde_cps$re78, y0 = eval_lalonde_cps$re75,
D = eval_lalonde_cps$experimental,
covariates = covX)
```

*std_ipw_did_rc*  
*Standardized inverse probability weighted DiD estimator, with repeated cross-section data*

**Description**

*std_ipw_did_rc* is used to compute inverse probability weighted (IPW) estimators for the ATT in DID setups with stationary repeated cross-sectional data. IPW weights are normalized to sum up to one, that is, the estimator is of the Hajek type.
Usage

std_ipw_did_rc(
  y,
  post,
  D,
  covariates,
  i.weights = NULL,
  boot = FALSE,
  boot.type = "weighted",
  nboot = NULL,
  inffunc = FALSE
)

Arguments

y An \( n \times 1 \) vector of outcomes from the both pre and post-treatment periods.

post An \( n \times 1 \) vector of Post-Treatment dummies (post = 1 if observation belongs
to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)

D An \( n \times 1 \) vector of Group indicators (=1 if observation is treated in the post-
treatment, =0 otherwise).

covariates An \( n \times k \) matrix of covariates to be used in the propensity score estimation. If
covariates = NULL, this leads to an unconditional DID estimator.

i.weights An \( n \times 1 \) vector of weights to be used. If NULL, then every observation has the
same weights.

boot Logical argument to whether bootstrap should be used for inference. Default is
FALSE.

boot.type Type of bootstrap to be performed (not relevant if boot = FALSE). Options are
"weighted" and "multiplier". If boot = TRUE, default is "weighted".

nboot Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.

inffunc Logical argument to whether influence function should be returned. Default is
FALSE.

Value

A list containing the following components:

ATT The IPW DID point estimate.

se The IPW DID standard error

uci Estimate of the upper bound of a 95% CI for the ATT

lci Estimate of the lower bound of a 95% CI for the ATT

boots All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference.
Default is NULL

att.inf.func Estimate of the influence function. Default is NULL

call.param The matched call.
Some arguments used (explicitly or not) in the call (panel = FALSE, normalized = TRUE, boot, boot.type, nboot, type="ipw")

References


Examples

# use the simulated data provided in the package
covX = as.matrix(sim_rc[,5:8])
# Implement normalized IPW DID estimator
std_ipw_did_rc(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d,
              covariates= covX)

twfe_did_panel

Two-way fixed effects DiD estimator, with panel data

description

twfe_did_panel is used to compute linear two-way fixed effects estimators for the ATT in difference-in-differences (DiD) setups with panel data. As illustrated by Sant’Anna and Zhao (2020), this estimator generally do not recover the ATT. We encourage empiricists to adopt alternative specifications.

Usage

twfe_did_panel(
    y1,
    y0,
    D,
    covariates,
    i.weights = NULL,
    boot = FALSE,
    boot.type = "weighted",
    nboot = NULL,
    inffunc = FALSE
  )
Arguments

\texttt{y1} \quad An \ n \times 1 \ vector \ of \ outcomes \ from \ the \ post-treatment \ period.
\texttt{y0} \quad An \ n \times 1 \ vector \ of \ outcomes \ from \ the \ pre-treatment \ period.
\texttt{D} \quad An \ n \times 1 \ vector \ of \ Group \ indicators \ (=1 \ if \ observation \ is \ treated \ in \ the \ post-treatment, =0 \ otherwise).
\texttt{covariates} \quad An \ n \times k \ matrix \ of \ covariates \ to \ be \ used \ in \ the \ regression \ estimation.
\texttt{i.weights} \quad An \ n \times 1 \ vector \ of \ weights \ to \ be \ used. \ If \ NULL, \ then \ every \ observation \ has \ the \ same \ weights.
\texttt{boot} \quad Logical \ argument \ to \ whether \ bootstrap \ should \ be \ used \ for \ inference. \ Default \ is \ FALSE.
\texttt{boot.type} \quad Type \ of \ bootstrap \ to \ be \ performed \ (not \ relevant \ if \ \texttt{boot} = \texttt{FALSE}). \ Options \ are \ "weighted" \ and \ "multiplier". \ If \ \texttt{boot} = \texttt{TRUE}, \ default \ is \ "weighted".
\texttt{nboot} \quad Number \ of \ bootstrap \ repetitions \ (not \ relevant \ if \ \texttt{boot} = \texttt{FALSE}). \ Default \ is \ 999.
\texttt{inffunc} \quad Logical \ argument \ to \ whether \ influence \ function \ should \ be \ returned. \ Default \ is \ FALSE.

Value

A list containing the following components:

\texttt{ATT} \quad The \ TWFE \ DID \ point \ estimate
\texttt{se} \quad The \ TWFE \ DID \ standard \ error
\texttt{uci} \quad Estimate \ of \ the \ upper \ bound \ of \ a \ 95\% \ CI \ for \ the \ TWFE \ parameter.
\texttt{lci} \quad Estimate \ of \ the \ lower \ bound \ of \ a \ 95\% \ CI \ for \ the \ TWFE \ parameter.
\texttt{boots} \quad All \ Bootstrap \ draws \ of \ the \ ATT, \ in \ case \ bootstrap \ was \ used \ to \ conduct \ inference. \ Default \ is \ NULL
\texttt{att.inf.func} \quad Estimate \ of \ the \ influence \ function. \ Default \ is \ NULL

Examples

# Form the Lalonde sample with CPS comparison group
eval_lalonde_cps <- subset(nsw, nsw$treated == 0 | nsw$sample == 2)
# Select some covariates
covX = as.matrix(cbind(eval_lalonde_cps$age, eval_lalonde_cps$educ,
    eval_lalonde_cps$black, eval_lalonde_cps$married,
    eval_lalonde_cps$nodegree, eval_lalonde_cps$hisp,
    eval_lalonde_cps$re74))
# Implement TWFE DID with panel data
twfe_did_panel(y1 = eval_lalonde_cps$re78, y0 = eval_lalonde_cps$re75,
    D = eval_lalonde_cps$experimental,
    covariates = covX)
twfe_did_rc  \hspace{1cm} Two-way fixed effects DiD estimator, with repeated cross-section data

Description

twfe_did_rc is used to compute linear two-way fixed effects estimators for the ATT in difference-in-differences (DiD) setups with stationary repeated cross-sectional data. As illustrated by Sant’Anna and Zhao (2020), this estimator generally do not recover the ATT. We encourage empiricists to adopt alternative specifications.

Usage

twfe_did_rc(
  y,
  post,
  D,
  covariates = NULL,
  i.weights = NULL,
  boot = FALSE,
  boot.type = "weighted",
  nboot = NULL,
  inffunc = FALSE
)

Arguments

y  \hspace{1cm} An n x 1 vector of outcomes from the both pre and post-treatment periods.
post  \hspace{1cm} An n x 1 vector of Post-Treatment dummies (post = 1 if observation belongs to post-treatment period, and post = 0 if observation belongs to pre-treatment period.)
D  \hspace{1cm} An n x 1 vector of Group indicators (=1 if observation is treated in the post-treatment period, =0 otherwise).
covariates  \hspace{1cm} An n x k matrix of covariates to be used in the regression estimation.
i.weights  \hspace{1cm} An n x 1 vector of weights to be used. If NULL, then every observation has the same weights.
boot  \hspace{1cm} Logical argument to whether bootstrap should be used for inference. Default is FALSE.
boot.type  \hspace{1cm} Type of bootstrap to be performed (not relevant if boot = FALSE). Options are "weighted" and "multiplier". If boot = TRUE, default is "weighted".
nboot  \hspace{1cm} Number of bootstrap repetitions (not relevant if boot = FALSE). Default is 999.
inffunc  \hspace{1cm} Logical argument to whether influence function should be returned. Default is FALSE.
Value

A list containing the following components:

- **ATT**: The TWFE DID point estimate
- **se**: The TWFE DID standard error
- **uci**: Estimate of the upper bound of a 95% CI for the TWFE parameter.
- **lci**: Estimate of the lower bound of a 95% CI for the TWFE parameter.
- **boots**: All Bootstrap draws of the ATT, in case bootstrap was used to conduct inference. Default is NULL.
- **att.inf.func**: Estimate of the influence function. Default is NULL.

Examples

```r
# use the simulated data provided in the package
covX = as.matrix(sim_rc[,5:8])
# Implement TWFE DID estimator (you probably should consider something else....)
twfe_did_rc(y = sim_rc$y, post = sim_rc$post, D = sim_rc$d, covariates= covX)
```
Index

**datasets**

- nsw, 24
- nsw_long, 25
- sim_rc, 32

- drdid, 3
- DRDID-package, 2
- drdid_imp_panel, 6
- drdid_imp_rc, 8
- drdid_imp_rc1, 10
- drdid_panel, 12
- drdid_rc, 14
- drdid_rc1, 16

- ipw_did_panel, 20
- ipw_did_rc, 22
- ipwdid, 18

- nsw, 24
- nsw_long, 25

- ordid, 26

- reg_did_panel, 28
- reg_did_rc, 30

- sim_rc, 32
- std_ipw_did_panel, 33
- std_ipw_did_rc, 34

- twfe_did_panel, 36
- twfe_did_rc, 38