

# Package ‘ptetools’

July 20, 2026

**Title** Panel Treatment Effects Tools

**Version** 1.0.1

**URL** <https://github.com/bcallaway11/ptetools>

**BugReports** <https://github.com/bcallaway11/ptetools/issues>

**Description** Generic code for estimating treatment effects with panel data. The idea is to break into separate steps organizing the data, looping over groups and time periods, computing group-time average treatment effects, and aggregating group-time average treatment effects. Often, one is able to implement a new identification/estimation procedure by simply replacing the step on estimating group-time average treatment effects. See several different examples of this approach in the package documentation.

**Depends** R (>= 4.1.0)

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Imports** BMisc (>= 1.4.8), Matrix, ggplot2, DRDID, data.table, dplyr, pbapply, splines2

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**Config/testthat/edition** 3

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aggte\_obj

*Aggregated Treatment Effects Class***Description**

Objects of this class hold results on aggregated group-time average treatment effects. This is derived from the AGGTEobj class in the did package.

An object for holding aggregated treatment effect parameters.

**Usage**

```
aggte_obj(
  overall.att = NULL,
  overall.se = NULL,
  type = "simple",
  egt = NULL,
  att.egt = NULL,
  se.egt = NULL,
  crit.val.egt = NULL,
  inf.function = NULL,
  min_e = NULL,
  max_e = NULL,
  balance_e = NULL,
  DIDparams = NULL
)
```

**Arguments**

|              |                                                                                                                                                |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| overall.att  | The estimated overall ATT                                                                                                                      |
| overall.se   | Standard error for overall ATT                                                                                                                 |
| type         | The type of aggregation to be done. Default is "overall".                                                                                      |
| egt          | Holds the length of exposure (for dynamic effects), the group (for selective treatment timing), or the time period (for calendar time effects) |
| att.egt      | The ATT specific to egt                                                                                                                        |
| se.egt       | The standard error specific to egt                                                                                                             |
| crit.val.egt | A critical value for computing uniform confidence bands for dynamic effects, selective treatment timing, or time period effects.               |
| inf.function | The influence function of the chosen aggregated parameters                                                                                     |
| min_e        | The minimum event time computed in the event study results. This is useful when there are a huge number of pre-treatment periods.              |
| max_e        | The maximum event time computed in the event study results. This is useful when there are a huge number of post-treatment periods.             |

|           |                                                                                                                                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| balance_e | Drops groups that do not have at least balance_e periods of post-treatment data. This keeps the composition of groups constant across different event times in an event study. Default is NULL, in which case this is ignored. |
| DIDparams | A DIDparams object                                                                                                                                                                                                             |

**Value**

an aggte\_obj

---

|          |                                                                 |
|----------|-----------------------------------------------------------------|
| attgt_if | <i>Class for (g,t)-Specific Results with Influence Function</i> |
|----------|-----------------------------------------------------------------|

---

**Description**

Class for holding group-time average treatment effects along with their influence function

**Usage**

```
attgt_if(attgt, inf_func, extra_gt_returns = NULL)
```

**Arguments**

|                  |                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt            | group-time average treatment effect                                                                                                                                                                                                                                                                                                                                     |
| inf_func         | influence function                                                                                                                                                                                                                                                                                                                                                      |
| extra_gt_returns | A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging. |

**Value**

attgt\_if object

attgt\_noif

*Class for (g,t)-Specific Results without Influence Function***Description**

Class for holding returns from group-time specific estimates in settings when an influence function is not returned

**Usage**

```
attgt_noif(attgt, extra_gt_returns = NULL)
```

**Arguments**

attgt                    group-time average treatment effect

extra\_gt\_returns

A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging.

**Value**

an attgt\_noif object

attgt\_pte\_aggregations

*Aggregate Group-Time Average Treatment Effects***Description**

Aggregate group-time average treatment effects into overall, group, and dynamic effects. This function is only used for (i) computing standard errors using the empirical bootstrap, and (ii) combining distributions at the (g,t) level

**Usage**

```
attgt_pte_aggregations(attgt.list, ptep)
```

**Arguments**

attgt.list            list of attgt results from compute\_pte

ptep                    pte\_params object

**Value**

pte\_emp\_boot object

---

autoplot.dose\_obj      *autoplot.dose\_obj*

---

**Description**

Plot dose-specific results for a continuous treatment.

**Usage**

```
## S3 method for class 'dose_obj'
autoplot(object, type = "att", ...)
```

**Arguments**

|        |                                           |
|--------|-------------------------------------------|
| object | a dose_obj object                         |
| type   | whether to plot "att" (default) or "acrt" |
| ...    | unused                                    |

**Value**

a ggplot object

---

autoplot.pte\_emp\_boot    *autoplot.pte\_emp\_boot*

---

**Description**

Event-study plot for a pte\_emp\_boot object returned by empirical-bootstrap estimators (e.g., `cic()`, `qdid()`, `mdid()`). Pre- and post-treatment periods are distinguished by color.

**Usage**

```
## S3 method for class 'pte_emp_boot'
autoplot(object, ...)
```

**Arguments**

|        |                       |
|--------|-----------------------|
| object | a pte_emp_boot object |
| ...    | unused                |

**Value**

a ggplot object

---

|                  |                         |
|------------------|-------------------------|
| autoplot.pte_qtt | <i>autoplot.pte_qtt</i> |
|------------------|-------------------------|

---

## Description

Plot a pte\_qtt object.

For type = "overall": QTT curve with quantile on the x-axis.

For type = "dynamic": event-study plot with event time on the x-axis. Each selected quantile is a separate colored line. CIs are shown by default when a single quantile is plotted, and suppressed by default when multiple quantiles are plotted.

## Usage

```
## S3 method for class 'pte_qtt'
autoplot(
  object,
  type = "overall",
  cband = TRUE,
  plot_probs = 0.5,
  plot_ci = NULL,
  ...
)
```

## Arguments

|            |                                                                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| object     | a pte_qtt object                                                                                                                                                |
| type       | which aggregation to plot: "overall" (default) or "dynamic". "group" is a stub.                                                                                 |
| cband      | logical; if TRUE (default), show uniform confidence band; if FALSE, show point-wise intervals. Applies when CIs are displayed.                                  |
| plot_probs | numeric vector of quantile levels to show in the dynamic plot. Defaults to 0.5 (median). All values must be present in object\$dynamic\$probs.                  |
| plot_ci    | logical or NULL. If NULL (default), CIs are shown when length(plot_probs) == 1 and suppressed otherwise. Set TRUE to always show CIs, FALSE to never show them. |
| ...        | unused                                                                                                                                                          |

## Value

a ggplot object

---

|                      |                             |
|----------------------|-----------------------------|
| autoplot.pte_results | <i>autoplot.pte_results</i> |
|----------------------|-----------------------------|

---

**Description**

Event-study plot for a pte\_results object. Pre- and post-treatment periods are distinguished by color.

**Usage**

```
## S3 method for class 'pte_results'
autoplot(object, ...)
```

**Arguments**

|        |                      |
|--------|----------------------|
| object | a pte_results object |
| ...    | unused               |

**Value**

a ggplot object

---

|             |                                       |
|-------------|---------------------------------------|
| compute.pte | <i>Heavy-Lifting for pte Function</i> |
|-------------|---------------------------------------|

---

**Description**

Function that actually computes panel treatment effects. The difference relative to compute.pte is that this function loops over time periods first (instead of groups) and tries to estimate model for untreated potential outcomes jointly for all groups.

**Usage**

```
compute.pte(pte, subset_fun, attgt_fun, ...)
```

**Arguments**

|            |                                                                                                                                                                                                                                                                                                                                                                                  |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| pte        | pte_params object                                                                                                                                                                                                                                                                                                                                                                |
| subset_fun | This is a function that should take in data, g (for group), tp (for time period), and ... and be able to return the appropriate data.frame that can be used by attgt_fun to produce ATT(g=g, t=tp). The data frame should be constructed using gt_data_frame in order to guarantee that it has the appropriate columns that identify which group an observation belongs to, etc. |



|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt_fun | <p>This is a function that should work in the case where there is a single group and the "right" number of time periods to recover an estimate of the ATT. For example, in the context of difference in differences, it would need to work for a single group, find the appropriate comparison group (untreated units), find the right time periods (pre- and post-treatment), and then recover an estimate of ATT for that group. It will be called over and over separately by groups and by time periods to compute <math>ATT(g,t)</math>'s.</p> <p>The function needs to work in a very specific way. It should take in the arguments: data, . . . data should be constructed using the function <code>gt_data_frame</code> which checks to make sure that data has the correct columns defined. . . . are additional arguments (such as formulas for covariates) that <code>attgt_fun</code> needs. From these arguments <code>attgt_fun</code> must return a list with element <code>ATT</code> containing the group-time average treatment effect for that group and that time period. If <code>attgt_fun</code> returns an influence function (which should be provided in a list element named <code>inf_func</code>), then the code will use the multiplier bootstrap to compute standard errors for group-time average treatment effects, an overall treatment effect parameter, and a dynamic treatment effect parameter (i.e., event study parameter). If <code>attgt_fun</code> does not return an influence function, then the same objects will be computed using the empirical bootstrap. This is usually (perhaps substantially) easier to code, but also will usually be (perhaps substantially) computationally slower.</p> |
| . . .     | <p>extra arguments that can be passed to create the correct subsets of the data (depending on <code>subset_fun</code>), to estimate group time average treatment effects (depending on <code>attgt_fun</code>), or to aggregating treatment effects (particularly useful are <code>min_e</code>, <code>max_e</code>, and <code>balance_e</code> arguments to event study aggregations)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## Value

a list containing the following elements:

- `attgt.list`: list of  $ATT(g,t)$  estimates
- `inf_func`: influence function matrix
- `extra_gt_returns`: list of extra returns from gt-specific calculations

---

covid\_attgt

*Covid ATT(g,t) Estimator*


---

## Description

Computes a group-time average treatment effect and influence function using an unconfoundedness-type identification strategy. This estimator is appropriate when parallel trends is implausible but a selection-on-observables assumption holds in levels (rather than differences) — e.g., during the early COVID-19 pandemic.

Originally from Callaway and Li (2021). Moved into `ptetools` from the `ppe` package.

**Usage**

```
covid_atttgt(gt_data, xformula, d_outcome = FALSE, d_covs_formula = ~-1, ...)
```

**Arguments**

|                             |                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <code>gt_data</code>        | data that is "local" to a particular group-time average treatment effect, structured as a <code>gt_data_frame</code>      |
| <code>xformula</code>       | one-sided formula for covariates used in the propensity score and outcome regression models                               |
| <code>d_outcome</code>      | logical; if TRUE, use first-differenced outcomes. Default is FALSE (levels).                                              |
| <code>d_covs_formula</code> | one-sided formula for covariates to include as changes (differences). Default is <code>~-1</code> (no change covariates). |
| <code>...</code>            | extra arguments; not used                                                                                                 |

**Value**

`atttgt_if` object

**References**

Callaway, B. and Li, T. (2021). Policy Evaluation during a Pandemic. <https://arxiv.org/abs/2105.06927>

---

|                         |                                  |
|-------------------------|----------------------------------|
| <code>covid_data</code> | <i>State-level Covid-19 Data</i> |
|-------------------------|----------------------------------|

---

**Description**

A panel dataset containing Covid-19 related data for 46 states. This data comes from Callaway and Li (2021). See the paper for additional descriptions.

**Usage**

```
covid_data
```

**Format**

A data frame with 1656 rows and 9 variables:

**positive** The cumulative number of cases per million individuals in a particular state by a particular time period.

**time.period** Time period

**group** The group that a state belongs to. It is based on the time period when they enacted the shelter-in-place order.

**state** State abbreviation

**totalTestResults** The total Covid-19 number of tests run per million individuals in a particular state by a particular time period.

**state\_id** Numeric state identifier

**region** Census region for particular state

**retail\_and\_recreation\_percent\_change\_from\_baseline** The percentage change in retail and recreational travel from pre-Covid baseline. This is from Google's Mobility report (see paper for details).

**current** The current number of cases per million individuals in a particular state by a particular time period. This variable is constructed from positive (see paper for details).

## Source

Callaway and Li (2021)

---

|                 |                                         |
|-----------------|-----------------------------------------|
| crit_val_checks | <i>Sanity Checks on Critical Values</i> |
|-----------------|-----------------------------------------|

---

## Description

A function to perform sanity checks and possibly adjust a critical value to form a uniform confidence band

## Usage

```
crit_val_checks(crit_val, alp = 0.05)
```

## Arguments

|          |                        |
|----------|------------------------|
| crit_val | the critical value     |
| alp      | the significance level |

## Value

a (possibly adjusted) critical value

---

|           |                                               |
|-----------|-----------------------------------------------|
| did_attgt | <i>Difference-in-differences for ATT(g,t)</i> |
|-----------|-----------------------------------------------|

---

### Description

Takes a `data.frame` and computes for a particular group `g` and time period `t` and computes an estimate of a group time average treatment effect and a corresponding influence function using a difference in differences approach.

The code relies on `gt_data` having certain variables defined. In particular, there should be an `id` column (individual identifier), `D` (treated group identifier), `period` (time period), `name` (equal to "pre" for pre-treatment periods and equal to "post" for post treatment periods), `Y` (outcome).

In our case, we call `two_by_two_subset` which sets up the data to have this format before the call to `did_attgt`.

### Usage

```
did_attgt(gt_data, xformula = ~1, ...)
```

### Arguments

|                       |                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------|
| <code>gt_data</code>  | data that is "local" to a particular group-time average treatment effect                    |
| <code>xformula</code> | one-sided formula for covariates used in the propensity score and outcome regression models |
| <code>...</code>      | extra function arguments; not used here                                                     |

### Value

`attgt_if`

---

|               |                                                                       |
|---------------|-----------------------------------------------------------------------|
| did_rcs_attgt | <i>Repeated Cross Sections Difference-in-Differences for ATT(g,t)</i> |
|---------------|-----------------------------------------------------------------------|

---

### Description

Takes a local repeated cross sections data set and computes an estimate of a group-time average treatment effect and corresponding influence function using a repeated cross sections DID approach.

### Usage

```
did_rcs_attgt(gt_data, xformula = ~1, est_method = "dr", ...)
```

**Arguments**

|            |                                                                                                                                 |
|------------|---------------------------------------------------------------------------------------------------------------------------------|
| gt_data    | data that is "local" to a particular group-time average treatment effect                                                        |
| xformula   | one-sided formula for covariates used in the propensity score and outcome regression models                                     |
| est_method | Which type of estimation method to use. Default is "dr" for doubly robust. The other option is "reg" for regression adjustment. |
| ...        | extra function arguments; not used here                                                                                         |

**Value**

attgt\_if

---

dose\_obj

*Class for Continuous Treatments*

---

**Description**

Holds results from computing dose-specific treatment effects with a continuous treatment

**Usage**

```
dose_obj(
  dose,
  overall_att = NULL,
  overall_att_se = NULL,
  overall_att_inffunc = NULL,
  overall_acrt = NULL,
  overall_acrt_se = NULL,
  overall_acrt_inffunc = NULL,
  att.d = NULL,
  att.d_se = NULL,
  att.d_crit.val = NULL,
  att.d_inffunc = NULL,
  acrt.d = NULL,
  acrt.d_se = NULL,
  acrt.d_crit.val = NULL,
  acrt.d_inffunc = NULL,
  pte_params = NULL
)
```

**Arguments**

|                |                                                               |
|----------------|---------------------------------------------------------------|
| dose           | vector containing the values of the dose used in estimation   |
| overall_att    | estimate of the overall ATT, the mean of ATT(D) given $D > 0$ |
| overall_att_se | the standard error of the estimate of overall_att             |

|                                   |                                                                                     |
|-----------------------------------|-------------------------------------------------------------------------------------|
| <code>overall_att_inffunc</code>  | the influence function for estimating <code>overall_att</code>                      |
| <code>overall_acrt</code>         | estimate of the overall ACRT, the mean of $ACRT(D D)$ given $D > 0$                 |
| <code>overall_acrt_se</code>      | the standard error for the estimate of <code>overall_acrt</code>                    |
| <code>overall_acrt_inffunc</code> | the influence function for estimating <code>overall_acrt</code>                     |
| <code>att.d</code>                | estimates of $ATT(d)$ for each value of dose                                        |
| <code>att.d_se</code>             | standard error of $ATT(d)$ for each value of dose                                   |
| <code>att.d_crit.val</code>       | critical value to produce pointwise or uniform confidence interval for $ATT(d)$     |
| <code>att.d_inffunc</code>        | matrix containing the influence function from estimating $ATT(d)$                   |
| <code>acrt.d</code>               | estimates of $ACRT(d)$ for each value of dose                                       |
| <code>acrt.d_se</code>            | standard error of $ACRT(d)$ for each value of dose                                  |
| <code>acrt.d_crit.val</code>      | critical value to produce pointwise or uniform confidence interval for $ACRT(d)$    |
| <code>acrt.d_inffunc</code>       | matrix containing the influence function from estimating $ACRT(d)$                  |
| <code>pte_params</code>           | a <code>pte_params</code> object containing other parameters passed to the function |

**Value**

a `dose_obj` object

---

`ggpte`

*ggpte*

---

**Description**

Deprecated. Use `autoplot()` on the `pte_results` object instead.

**Usage**

```
ggpte(pte_results)
```

**Arguments**

`pte_results` a `pte_results` object

**Value**

a `ggplot` object

---

|            |                   |
|------------|-------------------|
| ggpte_cont | <i>ggpte_cont</i> |
|------------|-------------------|

---

**Description**

Deprecated. Use autoplot() on the dose\_obj instead.

**Usage**

```
ggpte_cont(dose_obj, type = "att")
```

**Arguments**

|          |                                           |
|----------|-------------------------------------------|
| dose_obj | a dose_obj object                         |
| type     | whether to plot "att" (default) or "acrt" |

**Value**

a ggplot object

---

|                |                                                   |
|----------------|---------------------------------------------------|
| group_time_att | <i>Class for Estimates across Groups and Time</i> |
|----------------|---------------------------------------------------|

---

**Description**

Class that holds causal effect parameter estimates across timing groups and time periods

**Usage**

```
group_time_att(
  group,
  time.period,
  att,
  V_analytical,
  se,
  crit_val,
  inf_func,
  n,
  W,
  Wpval,
  cband,
  alp,
  ptep,
  extra_gt_returns
)
```

**Arguments**

|                  |                                                                                         |
|------------------|-----------------------------------------------------------------------------------------|
| group            | numeric vector of groups for ATT(g,t)                                                   |
| time.period      | numeric vector of time periods for ATT(g,t)                                             |
| att              | numeric vector containing the value of ATT(g,t) for corresponding group and time period |
| V_analytical     | analytical asymptotic variance matrix for ATT(g,t)'s                                    |
| se               | numeric vector of standard errors                                                       |
| crit_val         | critical value (usually a critical value for conducting uniform inference)              |
| inf_func         | matrix of influence function                                                            |
| n                | number of unique individuals                                                            |
| W                | Wald statistic for ATT(g,t) version of pre-test of parallel trends assumption           |
| Wpval            | p-value for Wald pre-test of ATT(g,t) version of parallel trends assumption             |
| cband            | logical indicating whether or not to report a confidence band                           |
| alp              | significance level                                                                      |
| ptep             | pte_params object                                                                       |
| extra_gt_returns | list containing extra returns at the group-time level                                   |

**Value**

object of class group\_time\_att

---

|               |                                      |
|---------------|--------------------------------------|
| gt_data_frame | <i>Convert Data to Usable Format</i> |
|---------------|--------------------------------------|

---

**Description**

Checks and converts data to satisfy criteria to be used in internal ptetools functions. In particular, the function takes in a data.frame, checks if it has the right columns to be used to calculate a group-time average treatment effect, and sets the class of the data.frame to include gt\_data\_frame

**Usage**

```
gt_data_frame(data)
```

**Arguments**

|      |                                                                                                         |
|------|---------------------------------------------------------------------------------------------------------|
| data | data that will be checked to see if has right format for computing group-time average treatment effects |
|------|---------------------------------------------------------------------------------------------------------|

**Value**

gt\_data\_frame object



---

keep\_all\_pretreatment\_subset

*Keep All Pre-Treatment Subset*


---

### Description

A function that takes an original data set and keeps all data for all groups that are not-yet-treated by period `tp` as well as for group `g`.

In particular, this keeps more data than functions like `two_by_two_subset` that use a fixed base period.

A main use case for this function is the interactive fixed effects approach proposed in Callaway and Tsyawo (2023).

### Usage

```
keep_all_pretreatment_subset(data, g, tp, ...)
```

### Arguments

|                   |                         |
|-------------------|-------------------------|
| <code>data</code> | the full dataset        |
| <code>g</code>    | the current group       |
| <code>tp</code>   | the current time period |
| <code>...</code>  | additional arguments    |

### Value

list that contains the following elements:

- `gt_data`: a `gt_data_frame` object that contains the correct subset of data
- `n1`: the number of observations in this subset
- `disidx`: a vector of the correct ids for this subset

---

keep\_all\_untreated\_subset

*Keep All Untreated Subset*


---

### Description

A function that takes an original data set and keeps all pre-treatment data for all groups. For group `g`, it also includes data for the current period.

Also, note that if `tp` is still a pre-treatment period for group `g`, then periods after `tp` will also be dropped for group `g`. This is a design choice and is useful especially for estimating placebo group-time average treatment effects in pre-treatment periods.

A main use case for this function is to compute  $ATT(g,t)$ 's using a global estimation strategy such as imputation in Gardner (2022).

**Usage**

```
keep_all_untreated_subset(data, g, tp, ...)
```

**Arguments**

|      |                                           |
|------|-------------------------------------------|
| data | the full dataset                          |
| g    | the current group                         |
| tp   | the current time period                   |
| ...  | extra arguments to get the subset correct |

**Value**

list that contains the following elements:

- `gt_data`: a `gt_data_frame` object that contains the correct subset of data
- `n1`: the number of observations in this subset
- `disidx`: a vector of the correct ids for this subset

---

mboot2

---

*Multiplier Bootstrap*


---

**Description**

Function for using multiplier bootstrap to conduct inference

**Usage**

```
mboot2(inffunc, biters = 1000, alp = 0.05)
```

**Arguments**

|         |                                                |
|---------|------------------------------------------------|
| inffunc | influence function matrix                      |
| biters  | number of bootstrap iterations; default is 100 |
| alp     | significance level; default is 0.05            |

**Value**

list with the following elements:

- `boot_se`: bootstrap standard errors
- `crit_val`: critical value for uniform confidence bands

---

|                 |                                        |
|-----------------|----------------------------------------|
| overall_weights | <i>Weights for Overall Aggregation</i> |
|-----------------|----------------------------------------|

---

### Description

A function that returns weights on (g,t)'s to deliver overall (averaged across groups and time periods) treatment effect parameters

### Usage

```
overall_weights(attgt, balance_e = NULL, min_e = -Inf, max_e = Inf, ...)
```

### Arguments

|           |                                                                                                                                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt     | A group_time_att object to be aggregated                                                                                                                                                                                       |
| balance_e | Drops groups that do not have at least balance_e periods of post-treatment data. This keeps the composition of groups constant across different event times in an event study. Default is NULL, in which case this is ignored. |
| min_e     | The minimum event time computed in the event study results. This is useful when there are a huge number of pre-treatment periods.                                                                                              |
| max_e     | The maximum event time computed in the event study results. This is useful when there are a huge number of post-treatment periods.                                                                                             |
| ...       | extra arguments                                                                                                                                                                                                                |

### Value

a data.frame containing columns:

- group: the group
- time.period: the time period
- overall\_weight: the weight

---

|                           |                                  |
|---------------------------|----------------------------------|
| panel_empirical_bootstrap | <i>Panel Empirical Bootstrap</i> |
|---------------------------|----------------------------------|

---

### Description

Computes empirical bootstrap pointwise standard errors

**Usage**

```

panel_empirical_bootstrap(
  attgt.list,
  ptep,
  setup_pte_fun,
  subset_fun,
  attgt_fun,
  extra_gt_returns,
  aggte_fun = NULL,
  ...
)

```

**Arguments**

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt.list    | list of attgt results from compute_pte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| ptep          | pte_params object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| setup_pte_fun | <p>This is a function that should take in data, yname (the name of the outcome variable in data), gname (the name of the group variable), idname (the name of the id variable), and possibly other arguments such as the significance level <math>\alpha</math>, the number of bootstrap iterations <math>b</math>, and how many clusters for parallel computing in the bootstrap <math>c</math>. The key thing that needs to be figured out in this function is which groups and time periods <math>ATT(g,t)</math> should be computed in. The function should return a pte_params object which contains all of the parameters passed into the function as well as glist and tlist which should be ordered lists of groups and time periods for <math>ATT(g,t)</math> to be computed.</p> <p>This function also provides a good place for error handling related to the types of data that can be handled.</p> <p>The pte package contains the function setup_pte that is a lightweight function that basically just takes the data, omits the never-treated group from glist but includes all other groups and drops the first time period. This works in cases where ATT would be identified in the 2x2 case (i.e., where there are two time periods, no units are treated in the first period and the identification strategy "works" with access to a treated and untreated group and untreated potential outcomes for both groups in the first period) — for example, this approach works if DID is the identification strategy.</p> |
| subset_fun    | <p>This is a function that should take in data, g (for group), tp (for time period), and ... and be able to return the appropriate data.frame that can be used by attgt_fun to produce <math>ATT(g=g, t=tp)</math>. The data frame should be constructed using gt_data_frame in order to guarantee that it has the appropriate columns that identify which group an observation belongs to, etc.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| attgt_fun     | <p>This is a function that should work in the case where there is a single group and the "right" number of time periods to recover an estimate of the ATT. For example, in the context of difference in differences, it would need to work for a single group, find the appropriate comparison group (untreated units), find the right time periods (pre- and post-treatment), and then recover an estimate of ATT for that group. It will be called over and over separately by groups and by time periods to compute <math>ATT(g,t)</math>'s.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

The function needs to work in a very specific way. It should take in the arguments: `data, ...` `data` should be constructed using the function `gt_data_frame` which checks to make sure that `data` has the correct columns defined. `...` are additional arguments (such as formulas for covariates) that `attgt_fun` needs. From these arguments `attgt_fun` must return a list with element `ATT` containing the group-time average treatment effect for that group and that time period. If `attgt_fun` returns an influence function (which should be provided in a list element named `inf_func`), then the code will use the multiplier bootstrap to compute standard errors for group-time average treatment effects, an overall treatment effect parameter, and a dynamic treatment effect parameter (i.e., event study parameter). If `attgt_fun` does not return an influence function, then the same objects will be computed using the empirical bootstrap. This is usually (perhaps substantially) easier to code, but also will usually be (perhaps substantially) computationally slower.

|                               |                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>extra_gt_returns</code> | A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging.                 |
| <code>aggte_fun</code>        | An optional function for aggregating group-time treatment effects. When <code>NULL</code> (the default), the function is selected automatically based on <code>gt_type</code> .                                                                                                                                                                                                         |
| <code>...</code>              | extra arguments that can be passed to create the correct subsets of the data (depending on <code>subset_fun</code> ), to estimate group time average treatment effects (depending on <code>attgt_fun</code> ), or to aggregating treatment effects (particularly useful are <code>min_e</code> , <code>max_e</code> , and <code>balance_e</code> arguments to event study aggregations) |

## Value

`pte_emp_boot` object

---

|                            |                      |
|----------------------------|----------------------|
| <code>plot.dose_obj</code> | <i>plot.dose_obj</i> |
|----------------------------|----------------------|

---

## Description

Convenience wrapper around [autoplot.dose\\_obj](#).

## Usage

```
## S3 method for class 'dose_obj'
plot(x, ...)
```

## Arguments

|                  |                                          |
|------------------|------------------------------------------|
| <code>x</code>   | a <code>dose_obj</code> object           |
| <code>...</code> | passed to <code>autoplot.dose_obj</code> |

**Value**

invisibly returns the ggplot object

---

|                   |                          |
|-------------------|--------------------------|
| plot.pte_emp_boot | <i>plot.pte_emp_boot</i> |
|-------------------|--------------------------|

---

**Description**

Convenience wrapper around [autoplot.pte\\_emp\\_boot](#).

**Usage**

```
## S3 method for class 'pte_emp_boot'
plot(x, ...)
```

**Arguments**

|     |                                 |
|-----|---------------------------------|
| x   | a pte_emp_boot object           |
| ... | passed to autoplot.pte_emp_boot |

**Value**

invisibly returns the ggplot object

---

|              |                     |
|--------------|---------------------|
| plot.pte_qtt | <i>plot.pte_qtt</i> |
|--------------|---------------------|

---

**Description**

Convenience wrapper around [autoplot.pte\\_qtt](#).

**Usage**

```
## S3 method for class 'pte_qtt'
plot(x, type = "overall", cband = TRUE, plot_probs = 0.5, plot_ci = NULL, ...)
```

**Arguments**

|            |                                                                                   |
|------------|-----------------------------------------------------------------------------------|
| x          | a pte_qtt object                                                                  |
| type       | which aggregation to plot. See <a href="#">autoplot.pte_qtt</a> .                 |
| cband      | logical; if TRUE (default), show uniform confidence band.                         |
| plot_probs | numeric vector of quantile levels to show. See <a href="#">autoplot.pte_qtt</a> . |
| plot_ci    | logical or NULL. See <a href="#">autoplot.pte_qtt</a> .                           |
| ...        | passed to autoplot.pte_qtt                                                        |

**Value**

invisibly returns the ggplot object

---

|                  |                         |
|------------------|-------------------------|
| plot.pte_results | <i>plot.pte_results</i> |
|------------------|-------------------------|

---

**Description**

Convenience wrapper around [autoplot.pte\\_results](#).

**Usage**

```
## S3 method for class 'pte_results'
plot(x, ...)
```

**Arguments**

|     |                                |
|-----|--------------------------------|
| x   | a pte_results object           |
| ... | passed to autoplot.pte_results |

**Value**

invisibly returns the ggplot object

---

|                |                                 |
|----------------|---------------------------------|
| process_att_gt | <i>Process ATT(g,t) Results</i> |
|----------------|---------------------------------|

---

**Description**

Process ATT(g,t) results when influence function is available

**Usage**

```
process_att_gt(att_gt_results, ptep)
```

**Arguments**

|                |                   |
|----------------|-------------------|
| att_gt_results | ATT(g,t)'s        |
| ptep           | pte_params object |

**Value**

group\_time\_att object

---

|                 |                                                    |
|-----------------|----------------------------------------------------|
| process_dose_gt | <i>Process Results with a Continuous Treatment</i> |
|-----------------|----------------------------------------------------|

---

**Description**

After computing results for each group and time period, `process_dose_gt` combines/averages them into overall effects and/or dose specific effects. This is generic code that can be used from different ways of estimating causal effects across different timing groups and periods in a previous step.

**Usage**

```
process_dose_gt(gt_results, ptep, ...)
```

**Arguments**

|                         |                                     |
|-------------------------|-------------------------------------|
| <code>gt_results</code> | list of group-time specific results |
| <code>ptep</code>       | <code>pte_params</code> object      |
| <code>...</code>        | extra arguments                     |

**Value**

a `dose_obj` object

---

|     |                                |
|-----|--------------------------------|
| pte | <i>Panel Treatment Effects</i> |
|-----|--------------------------------|

---

**Description**

Tools for estimating treatment effects with panel data.  
Main function for computing panel treatment effects

**Usage**

```
pte(
  yname,
  gname,
  tname,
  idname = NULL,
  data,
  setup_pte_fun,
  subset_fun,
  attgt_fun,
  aggte_fun = NULL,
  panel = TRUE,
```



```

cband = TRUE,
alp = 0.05,
boot_type = "multiplier",
weightsname = NULL,
gt_type = "att",
ret_quantile = NULL,
global_fun = FALSE,
time_period_fun = FALSE,
group_fun = FALSE,
process_dtt_gt_fun = process_dtt_gt,
process_dose_gt_fun = process_dose_gt,
probs = NULL,
biters = 100,
cl = 1,
call = NULL,
...
)

```

### Arguments

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>yname</code>         | Name of outcome in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <code>gname</code>         | Name of group in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <code>tname</code>         | Name of time period in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <code>idname</code>        | Name of id in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>data</code>          | balanced panel or repeated cross sections data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <code>setup_pte_fun</code> | <p>This is a function that should take in <code>data</code>, <code>yname</code> (the name of the outcome variable in data), <code>gname</code> (the name of the group variable), <code>idname</code> (the name of the id variable), and possibly other arguments such as the significance level <code>alp</code>, the number of bootstrap iterations <code>biters</code>, and how many clusters for parallel computing in the bootstrap <code>cl</code>. The key thing that needs to be figured out in this function is which groups and time periods <math>ATT(g,t)</math> should be computed in. The function should return a <code>pte_params</code> object which contains all of the parameters passed into the function as well as <code>glist</code> and <code>tlist</code> which should be ordered lists of groups and time periods for <math>ATT(g,t)</math> to be computed.</p> <p>This function provides also provides a good place for error handling related to the types of data that can be handled.</p> <p>The <code>pte</code> package contains the function <code>setup_pte</code> that is a lightweight function that basically just takes the data, omits the never-treated group from <code>glist</code> but includes all other groups and drops the first time period. This works in cases where <math>ATT</math> would be identified in the 2x2 case (i.e., where there are two time periods, no units are treated in the first period and the identification strategy "works" with access to a treated and untreated group and untreated potential outcomes for both groups in the first period) — for example, this approach works if DID is the identification strategy.</p> |
| <code>subset_fun</code>    | <p>This is a function that should take in <code>data</code>, <code>g</code> (for group), <code>tp</code> (for time period), and <code>...</code> and be able to return the appropriate <code>data.frame</code> that can be used by <code>attgt_fun</code> to produce <math>ATT(g=g,t=tp)</math>. The data frame should be constructed</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | using <code>gt_data_frame</code> in order to guarantee that it has the appropriate columns that identify which group an observation belongs to, etc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <code>attgt_fun</code>    | <p>This is a function that should work in the case where there is a single group and the "right" number of time periods to recover an estimate of the ATT. For example, in the context of difference in differences, it would need to work for a single group, find the appropriate comparison group (untreated units), find the right time periods (pre- and post-treatment), and then recover an estimate of ATT for that group. It will be called over and over separately by groups and by time periods to compute <math>ATT(g,t)</math>'s.</p> <p>The function needs to work in a very specific way. It should take in the arguments: <code>data</code>, . . . <code>data</code> should be constructed using the function <code>gt_data_frame</code> which checks to make sure that <code>data</code> has the correct columns defined. . . . are additional arguments (such as formulas for covariates) that <code>attgt_fun</code> needs. From these arguments <code>attgt_fun</code> must return a list with element <code>ATT</code> containing the group-time average treatment effect for that group and that time period.</p> <p>If <code>attgt_fun</code> returns an influence function (which should be provided in a list element named <code>inf_func</code>), then the code will use the multiplier bootstrap to compute standard errors for group-time average treatment effects, an overall treatment effect parameter, and a dynamic treatment effect parameter (i.e., event study parameter). If <code>attgt_fun</code> does not return an influence function, then the same objects will be computed using the empirical bootstrap. This is usually (perhaps substantially) easier to code, but also will usually be (perhaps substantially) computationally slower.</p> |
| <code>aggte_fun</code>    | An optional function for aggregating group-time treatment effects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <code>panel</code>        | Whether the data are panel data. The default is <code>TRUE</code> . Set to <code>FALSE</code> for repeated cross sections.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>cband</code>        | whether or not to report a uniform (instead of pointwise) confidence band (default is <code>TRUE</code> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <code>alp</code>          | significance level; default is 0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <code>boot_type</code>    | should be one of "multiplier" (the default) or "empirical". The multiplier bootstrap is generally much faster, but <code>attgt_fun</code> needs to provide an expression for the influence function (which could be challenging to figure out). If no influence function is provided, then the <code>pte</code> package will use the empirical bootstrap no matter what the value of this parameter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <code>weightsname</code>  | The name of the column that contains sampling weights. The default is <code>NULL</code> , in which case no sampling weights are used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <code>gt_type</code>      | which type of group-time effects are computed. The default is "att". Different estimation strategies can implement their own choices for <code>gt_type</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <code>ret_quantile</code> | For functions that compute quantile treatment effects, this is a specific quantile at which to report results, e.g., <code>ret_quantile = 0.5</code> will return that the <code>qte</code> at the median.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <code>global_fun</code>   | Logical indicating whether or not untreated potential outcomes can be estimated in one shot, i.e., for all groups and time periods. Main use case would be for one-shot imputation estimators. Not supported yet.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>time_period_fun</code>     | Logical indicating whether or not untreated potential outcomes can be estimated for all groups in the same time period. Not supported yet.                                                                                                                                                                                                                                                            |
| <code>group_fun</code>           | Logical indicating whether or not untreated potential outcomes can be estimated for all time periods for a single group. Not supported yet. These functions aim at reducing or eliminating running the same code multiple times.                                                                                                                                                                      |
| <code>process_dtt_gt_fun</code>  | An optional function to customize results when the <code>gt</code> -specific function returns the distribution of treated and untreated potential outcomes. The default is <code>process_dtt_gt</code> , which is a function provided by the package. See that function for an example of what this function should return. This is unused except in cases where the results involve distributions.   |
| <code>process_dose_gt_fun</code> | An optional function to customize results when the <code>gt</code> -specific function returns treatment effects that depend on dose (i.e., amount of the treatment). The default is <code>process_dose_gt</code> , which is a function provided by the package. See that function for an example of what this function should return. This is unused except in cases where the results involve doses. |
| <code>probs</code>               | For <code>gt_type = "qtt"</code> , a numeric vector of quantile levels at which to evaluate the QTT curve. Defaults to <code>seq(0.05, 0.95, 0.05)</code> .                                                                                                                                                                                                                                           |
| <code>biters</code>              | number of bootstrap iterations; default is 100                                                                                                                                                                                                                                                                                                                                                        |
| <code>cl</code>                  | number of clusters to be used when bootstrapping; default is 1                                                                                                                                                                                                                                                                                                                                        |
| <code>call</code>                | keeps track of through the <code>call</code> from external functions/packages                                                                                                                                                                                                                                                                                                                         |
| <code>...</code>                 | extra arguments that can be passed to create the correct subsets of the data (depending on <code>subset_fun</code> ), to estimate group time average treatment effects (depending on <code>attgt_fun</code> ), or to aggregating treatment effects (particularly useful are <code>min_e</code> , <code>max_e</code> , and <code>balance_e</code> arguments to event study aggregations)               |

**Value**

`pte_results` object

**Author(s)**

**Maintainer:** Brantly Callaway <brantly.callaway@uga.edu>

Authors:

- Brantly Callaway <brantly.callaway@uga.edu>

**See Also**

Useful links:

- <https://github.com/bcallaway11/ptetools>
- Report bugs at <https://github.com/bcallaway11/ptetools/issues>

## Examples

```
# example using minimum wage data
# and difference-in-differences identification strategy
library(did)
data(mpdta)
did_res <- pte(
  yname = "lemp",
  gname = "first.treat",
  tname = "year",
  idname = "countyreal",
  data = mpdta,
  setup_pte_fun = setup_pte,
  subset_fun = two_by_two_subset,
  attgt_fun = did_attgt,
  xformula = ~lpop
)

summary(did_res)
ggplot2::autoplot(did_res)
```

---

pte\_aggte

*Aggregates (g,t)-Specific Results*

---

## Description

This is a slight edit of the aggte function from the did package. Currently, it only provides aggregations for "overall" treatment effects and event studies. It also will provide the weights directly which is currently used for constructing aggregations based on distributions. The other difference is that, pte\_aggte provides inference results where the only randomness is coming from the outcomes (not from the group assignment nor from the covariates).

## Usage

```
pte_aggte(
  attgt,
  type = "overall",
  balance_e = NULL,
  min_e = -Inf,
  max_e = Inf,
  ...
)
```

## Arguments

|       |                                                           |
|-------|-----------------------------------------------------------|
| attgt | A group_time_att object to be aggregated                  |
| type  | The type of aggregation to be done. Default is "overall". |

|           |                                                                                                                                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| balance_e | Drops groups that do not have at least balance_e periods of post-treatment data. This keeps the composition of groups constant across different event times in an event study. Default is NULL, in which case this is ignored. |
| min_e     | The minimum event time computed in the event study results. This is useful when there are a huge number of pre-treatment periods.                                                                                              |
| max_e     | The maximum event time computed in the event study results. This is useful when there are a huge number of post-treatment periods.                                                                                             |
| ...       | extra arguments                                                                                                                                                                                                                |

**Value**

an aggte\_obj

---

|           |                         |
|-----------|-------------------------|
| pte_attgt | <i>General ATT(g,t)</i> |
|-----------|-------------------------|

---

**Description**

pte\_attgt takes a "local" data.frame and computes an estimate of a group time average treatment effect and a corresponding influence function. This function generalizes a number of existing methods and underlies the pte\_default function.

The code relies on gt\_data having certain variables defined. In particular, there should be an id column (individual identifier), G (group identifier), period (time period), name (equal to "pre" for pre-treatment periods and equal to "post" for post treatment periods), Y (outcome).

In our case, we call two\_by\_two\_subset which sets up the data to have this format before the call to pte\_attgt

**Usage**

```
pte_attgt(
  gt_data,
  xformula,
  d_outcome = FALSE,
  d_covs_formula = ~-1,
  lagged_outcome_cov = FALSE,
  est_method = "dr",
  ...
)
```

**Arguments**

|           |                                                                                                                                          |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------|
| gt_data   | data that is "local" to a particular group-time average treatment effect                                                                 |
| xformula  | one-sided formula for covariates used in the propensity score and outcome regression models                                              |
| d_outcome | Whether or not to take the first difference of the outcome. The default is FALSE. To use difference-in-differences, set this to be TRUE. |

|                    |                                                                                                                                                                           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| d_covs_formula     | A formula for time varying covariates to enter the first estimation step models. The default is not to include any, and, hence, to only include pre-treatment covariates. |
| lagged_outcome_cov | Whether to include the lagged outcome as a covariate. Default is FALSE.                                                                                                   |
| est_method         | Which type of estimation method to use. Default is "dr" for doubly robust. The other option is "reg" for regression adjustment.                                           |
| ...                | extra function arguments; not used here                                                                                                                                   |

**Value**

attgt\_if

---

|             |                                                                                  |
|-------------|----------------------------------------------------------------------------------|
| pte_default | <i>Default, General Function for Computing Treatment Effects with Panel Data</i> |
|-------------|----------------------------------------------------------------------------------|

---

**Description**

This is a generic/example wrapper for a call to the pte function.

This function provides access to difference-in-differences and unconfoundedness based identification/estimation strategies given (i) panel data and (ii) staggered treatment adoption

**Usage**

```
pte_default(
  yname,
  gname,
  tname,
  idname = NULL,
  data,
  panel = TRUE,
  xformula = ~1,
  d_outcome = FALSE,
  d_covs_formula = ~-1,
  lagged_outcome_cov = FALSE,
  est_method = "dr",
  anticipation = 0,
  base_period = "varying",
  control_group = "notyettreated",
  weightsname = NULL,
  cband = TRUE,
  alp = 0.05,
  boot_type = "multiplier",
  biters = 100,
  cl = 1,
  ...
)
```

**Arguments**

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| yname              | Name of outcome in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| gname              | Name of group in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| tname              | Name of time period in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| idname             | Name of id in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| data               | balanced panel or repeated cross sections data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| panel              | Whether the data are panel data. The default is TRUE. Set to FALSE for repeated cross sections.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| xformula           | one-sided formula for covariates used in the propensity score and outcome regression models                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| d_outcome          | Whether or not to take the first difference of the outcome. The default is FALSE. To use difference-in-differences, set this to be TRUE.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| d_covs_formula     | A formula for time varying covariates to enter the first estimation step models. The default is not to include any, and, hence, to only include pre-treatment covariates.                                                                                                                                                                                                                                                                                                                                                                                                              |
| lagged_outcome_cov | Whether to include the lagged outcome as a covariate. Default is FALSE.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| est_method         | Which type of estimation method to use. Default is "dr" for doubly robust. The other option is "reg" for regression adjustment.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| anticipation       | how many periods before the treatment actually takes place that it can have an effect on outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| base_period        | The type of base period to use. This only affects the numeric value of results in pre-treatment periods. Results in post-treatment periods are not affected by this choice. The default is "varying", where the base period will "back up" to the immediately preceding period in pre-treatment periods. The other option is "universal" where the base period is fixed in pre-treatment periods to be the period right before the treatment starts. "Universal" is commonly used in difference-in-differences applications, but can be unnatural for other identification strategies. |
| control_group      | Which group is used as the comparison group. The default choice is "notyet-treated", but different estimation strategies can implement their own choices for the control group                                                                                                                                                                                                                                                                                                                                                                                                         |
| weightsname        | The name of the column that contains sampling weights. The default is NULL, in which case no sampling weights are used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| cband              | whether or not to report a uniform (instead of pointwise) confidence band (default is TRUE)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| alp                | significance level; default is 0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| boot_type          | should be one of "multiplier" (the default) or "empirical". The multiplier bootstrap is generally much faster, but at tgt_fun needs to provide an expression for the influence function (which could be challenging to figure out). If no influence function is provided, then the pte package will use the empirical bootstrap no matter what the value of this parameter.                                                                                                                                                                                                            |
| biters             | number of bootstrap iterations; default is 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| cl                 | number of clusters to be used when bootstrapping; default is 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| ...                | additional arguments passed to pte, such as min_e, max_e, and balance_e for controlling the event study range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Value**

pte\_results object

**Examples**

```
# example using minimum wage data
# and a lagged outcome unconfoundedness strategy
library(did)
data(mpdta)
lou_res <- pte_default(
  yname = "lemp",
  gname = "first.treat",
  tname = "year",
  idname = "countyreal",
  data = mpdta,
  xformula = ~lpop,
  d_outcome = FALSE,
  d_covs_formula = ~lpop,
  lagged_outcome_cov = TRUE
)

summary(lou_res)
ggplot2::autoplot(lou_res)
```

---

|                  |                                               |
|------------------|-----------------------------------------------|
| pte_dose_results | <i>Class for Continuous Treatment Results</i> |
|------------------|-----------------------------------------------|

---

**Description**

Class for holding results with a continuous treatment

**Usage**

```
pte_dose_results(att_gt, dose, att_d = NULL, acrt_d = NULL, ptep)
```

**Arguments**

|        |                                |
|--------|--------------------------------|
| att_gt | attgt results                  |
| dose   | vector of doses                |
| att_d  | ATT(d) for each value of dose  |
| acrt_d | ACRT(d) for each value of dose |
| ptep   | a pte_params object            |

**Value**

a pte\_dose\_results object



pte\_emp\_boot

*Class for Empirical Bootstrap Results***Description**

Class for holding ptetools empirical bootstrap results

**Usage**

```
pte_emp_boot(
  attgt_results,
  overall_results,
  group_results,
  dyn_results,
  overall_weights = NULL,
  dyn_weights = NULL,
  group_weights = NULL,
  extra_gt_returns = NULL,
  ptep = NULL
)
```

**Arguments**

|                  |                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt_results    | data.frame holding attgt results                                                                                                                                                                                                                                                                                                                                        |
| overall_results  | data.frame holding overall results                                                                                                                                                                                                                                                                                                                                      |
| group_results    | data.frame holding group results                                                                                                                                                                                                                                                                                                                                        |
| dyn_results      | data.frame holding dynamic results                                                                                                                                                                                                                                                                                                                                      |
| overall_weights  | vector containing weights on underlying ATT(g,t) for overall treatment effect parameter                                                                                                                                                                                                                                                                                 |
| dyn_weights      | list containing weights on underlying ATT(g,t) for each value of e corresponding to the dynamic treatment effect parameters.                                                                                                                                                                                                                                            |
| group_weights    | list containing weights on underlying ATT(g,t) corresponding to deliver averaged group-specific treatment effects                                                                                                                                                                                                                                                       |
| extra_gt_returns | A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging. |
| ptep             | pte_params object, stored for reference in the result.                                                                                                                                                                                                                                                                                                                  |

**Value**

a pte\_emp\_boot object

pte\_params

*PTE Parameters Class***Description**

Class that contains pte parameters

**Usage**

```
pte_params(
  yname,
  gname,
  tname,
  idname = NULL,
  data,
  panel = TRUE,
  glist,
  tlist,
  cband,
  alp,
  boot_type,
  anticipation = NULL,
  base_period = NULL,
  weightsname = NULL,
  control_group = "notyettreated",
  gt_type = "att",
  ret_quantile = 0.5,
  probs = NULL,
  global_fun = FALSE,
  time_period_fun = FALSE,
  group_fun = FALSE,
  biters,
  cl,
  call = NULL
)
```

**Arguments**

|        |                                                                                                 |
|--------|-------------------------------------------------------------------------------------------------|
| yname  | Name of outcome in data                                                                         |
| gname  | Name of group in data                                                                           |
| tname  | Name of time period in data                                                                     |
| idname | Name of id in data                                                                              |
| data   | balanced panel or repeated cross sections data                                                  |
| panel  | Whether the data are panel data. The default is TRUE. Set to FALSE for repeated cross sections. |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| glist           | list of groups to create group-time average treatment effects for                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| tlist           | list of time periods to create group-time average treatment effects for                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| cband           | whether or not to report a uniform (instead of pointwise) confidence band (default is TRUE)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| alp             | significance level; default is 0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| boot_type       | which type of bootstrap to use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| anticipation    | how many periods before the treatment actually takes place that it can have an effect on outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| base_period     | The type of base period to use. This only affects the numeric value of results in pre-treatment periods. Results in post-treatment periods are not affected by this choice. The default is "varying", where the base period will "back up" to the immediately preceding period in pre-treatment periods. The other option is "universal" where the base period is fixed in pre-treatment periods to be the period right before the treatment starts. "Universal" is commonly used in difference-in-differences applications, but can be unnatural for other identification strategies. |
| weightsname     | The name of the column that contains sampling weights. The default is NULL, in which case no sampling weights are used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| control_group   | Which group is used as the comparison group. The default choice is "notyet-treated", but different estimation strategies can implement their own choices for the control group                                                                                                                                                                                                                                                                                                                                                                                                         |
| gt_type         | which type of group-time effects are computed. The default is "att". Different estimation strategies can implement their own choices for gt_type                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ret_quantile    | For functions that compute quantile treatment effects, this is a specific quantile at which to report results, e.g., <code>ret_quantile = 0.5</code> will return that the qte at the median.                                                                                                                                                                                                                                                                                                                                                                                           |
| probs           | For <code>gt_type = "qtt"</code> , a numeric vector of quantile levels at which to evaluate the QTT curve (e.g., <code>seq(0.05, 0.95, 0.05)</code> ). Defaults to <code>seq(0.05, 0.95, 0.05)</code> when NULL.                                                                                                                                                                                                                                                                                                                                                                       |
| global_fun      | Logical indicating whether or not untreated potential outcomes can be estimated in one shot, i.e., for all groups and time periods. Main use case would be for one-shot imputation estimators. Not supported yet.                                                                                                                                                                                                                                                                                                                                                                      |
| time_period_fun | Logical indicating whether or not untreated potential outcomes can be estimated for all groups in the same time period. Not supported yet.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| group_fun       | Logical indicating whether or not untreated potential outcomes can be estimated for all time periods for a single group. Not supported yet. These functions aim at reducing or eliminating running the same code multiple times.                                                                                                                                                                                                                                                                                                                                                       |
| biters          | number of bootstrap iterations; default is 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| cl              | number of clusters to be used when bootstrapping; default is 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| call            | keeps track of through the call from external functions/packages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

**Value**

pte\_params object

---

|         |                                    |
|---------|------------------------------------|
| pte_qtt | <i>Class for QTT Curve Results</i> |
|---------|------------------------------------|

---

**Description**

Holds the full quantile treatment effect (QTT) curve at the overall, group-specific, and dynamic (event-study) aggregation levels. Each aggregation contains estimates at all quantile levels in probs together with bootstrap standard errors and pointwise confidence intervals.

**Usage**

```
pte_qtt(overall, dynamic, group, F0_overall = NULL, F1_overall = NULL, ptep)
```

**Arguments**

|            |                                                                                       |
|------------|---------------------------------------------------------------------------------------|
| overall    | data.frame with columns probs, qtt, se, lower_pw, upper_pw, lower_ub, upper_ub        |
| dynamic    | data.frame with columns e, probs, qtt, se, lower_pw, upper_pw, lower_ub, upper_ub     |
| group      | data.frame with columns group, probs, qtt, se, lower_pw, upper_pw, lower_ub, upper_ub |
| F0_overall | mixture CDF of untreated potential outcomes                                           |
| F1_overall | mixture CDF of treated potential outcomes                                             |
| ptep       | pte_params object                                                                     |

**Value**

a pte\_qtt object

---

|             |                              |
|-------------|------------------------------|
| pte_results | <i>Class for PTE Results</i> |
|-------------|------------------------------|

---

**Description**

Class for holding overall results with a staggered treatment, including an overall ATT and an event study

**Usage**

```
pte_results(att_gt, overall_att, event_study, ptep)
```

**Arguments**

|             |                     |
|-------------|---------------------|
| att_gt      | attgt results       |
| overall_att | overall_att results |
| event_study | event_study results |
| ptep        | pte_params object   |

**Value**

a pte\_results object

---

qott\_pte\_aggregations    *Aggregate Group-Time Quantile of the Treatment Effect*

---

**Description**

Aggregate group-time distribution of the treatment effect into overall, group, and dynamic effects.

**Usage**

```
qott_pte_aggregations(attgt.list, ptep, extra_gt_returns)
```

**Arguments**

attgt.list        list of attgt results from compute\_pte

ptep             pte\_params object

extra\_gt\_returns

A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging.

**Value**

pte\_emp\_boot object

---

qtt\_empirical\_bootstrap  
                           *Empirical Bootstrap for QTT Curves*

---

**Description**

Runs the empirical bootstrap for the full QTT curve case (gt\_type = "qtt"). Called automatically by panel\_empirical\_bootstrap when gt\_type == "qtt".

**Usage**

```

qtt_empirical_bootstrap(
  attgt.list,
  ptep,
  setup_pte_fun,
  subset_fun,
  attgt_fun,
  extra_gt_returns,
  aggte_fun = NULL,
  ...
)

```

**Arguments**

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt.list    | list of attgt results from compute_pte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| ptep          | pte_params object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| setup_pte_fun | <p>This is a function that should take in data, yname (the name of the outcome variable in data), gname (the name of the group variable), idname (the name of the id variable), and possibly other arguments such as the significance level <math>\alpha</math>, the number of bootstrap iterations <math>b</math>, and how many clusters for parallel computing in the bootstrap <math>c</math>. The key thing that needs to be figured out in this function is which groups and time periods <math>ATT(g,t)</math> should be computed in. The function should return a pte_params object which contains all of the parameters passed into the function as well as glist and tlist which should be ordered lists of groups and time periods for <math>ATT(g,t)</math> to be computed.</p> <p>This function also provides a good place for error handling related to the types of data that can be handled.</p> <p>The pte package contains the function setup_pte that is a lightweight function that basically just takes the data, omits the never-treated group from glist but includes all other groups and drops the first time period. This works in cases where ATT would be identified in the 2x2 case (i.e., where there are two time periods, no units are treated in the first period and the identification strategy "works" with access to a treated and untreated group and untreated potential outcomes for both groups in the first period) — for example, this approach works if DID is the identification strategy.</p> |
| subset_fun    | <p>This is a function that should take in data, g (for group), tp (for time period), and ... and be able to return the appropriate data.frame that can be used by attgt_fun to produce <math>ATT(g=g, t=tp)</math>. The data frame should be constructed using gt_data_frame in order to guarantee that it has the appropriate columns that identify which group an observation belongs to, etc.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| attgt_fun     | <p>This is a function that should work in the case where there is a single group and the "right" number of time periods to recover an estimate of the ATT. For example, in the context of difference in differences, it would need to work for a single group, find the appropriate comparison group (untreated units), find the right time periods (pre- and post-treatment), and then recover an estimate of ATT for that group. It will be called over and over separately by groups and by time periods to compute <math>ATT(g,t)</math>'s.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

The function needs to work in a very specific way. It should take in the arguments: data, . . . data should be constructed using the function `gt_data_frame` which checks to make sure that data has the correct columns defined. . . . are additional arguments (such as formulas for covariates) that `attgt_fun` needs. From these arguments `attgt_fun` must return a list with element `ATT` containing the group-time average treatment effect for that group and that time period. If `attgt_fun` returns an influence function (which should be provided in a list element named `inf_func`), then the code will use the multiplier bootstrap to compute standard errors for group-time average treatment effects, an overall treatment effect parameter, and a dynamic treatment effect parameter (i.e., event study parameter). If `attgt_fun` does not return an influence function, then the same objects will be computed using the empirical bootstrap. This is usually (perhaps substantially) easier to code, but also will usually be (perhaps substantially) computationally slower.

|                  |                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| extra_gt_returns | A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging.                 |
| aggte_fun        | An optional function for aggregating group-time treatment effects. When NULL (the default), the function is selected automatically based on <code>gt_type</code> .                                                                                                                                                                                                                      |
| ...              | extra arguments that can be passed to create the correct subsets of the data (depending on <code>subset_fun</code> ), to estimate group time average treatment effects (depending on <code>attgt_fun</code> ), or to aggregating treatment effects (particularly useful are <code>min_e</code> , <code>max_e</code> , and <code>balance_e</code> arguments to event study aggregations) |

Value

pte\_qtt object

---

|                      |                                                        |
|----------------------|--------------------------------------------------------|
| qtt_pte_aggregations | <i>Aggregate Group-Time Quantile Treatment Effects</i> |
|----------------------|--------------------------------------------------------|

---

Description

Aggregate group-time F0/F1 distributions into QTT curves at the overall, group, and dynamic level. CDFs are mixed first using `BMisc::combine_ecdfs` and then inverted at all quantile levels in `probs`, avoiding the bias from averaging scalar QTTs.

Usage

`qtt_pte_aggregations(attgt.list, ptep, extra_gt_returns)`

**Arguments**

|                  |                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| attgt.list       | list of attgt results from compute_pte                                                                                                                                                                                                                                                                                                                                  |
| ptep             | pte_params object                                                                                                                                                                                                                                                                                                                                                       |
| extra_gt_returns | A place to return anything extra from particular group-time average treatment effect calculations. For DID, this might be something like propensity score estimates, regressions of untreated potential outcomes on covariates. For ife, this could be something like the first step regression 2sls estimates. This argument is also potentially useful for debugging. |

**Value**

named list with elements overall\_results, dyn\_results, group\_results, F0\_overall, F1\_overall

---

|           |                               |
|-----------|-------------------------------|
| setup_pte | <i>Generic Setup Function</i> |
|-----------|-------------------------------|

---

**Description**

This is a function for how to setup the data to be used in the ptetools package.

The setup\_pte function builds on setup\_pte\_basic and attempts to provide a general purpose function (with error handling) to arrange the data in a way that can be processed by subset\_fun and attgt\_fun in the next steps.

**Usage**

```
setup_pte(
  yname,
  gname,
  tname,
  idname = NULL,
  data,
  panel = TRUE,
  required_pre_periods = 1,
  anticipation = 0,
  base_period = "varying",
  cband = TRUE,
  alp = 0.05,
  boot_type = "multiplier",
  weightsname = NULL,
  gt_type = "att",
  ret_quantile = 0.5,
  probs = NULL,
  biters = 100,
  cl = 1,
  call = NULL,
```



```
    ...
)
```

## Arguments

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| yname                | Name of outcome in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| gname                | Name of group in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| tname                | Name of time period in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| idname               | Name of id in data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| data                 | balanced panel or repeated cross sections data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| panel                | Whether the data are panel data. The default is TRUE. Set to FALSE for repeated cross sections.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| required_pre_periods | The number of required pre-treatment periods to implement the estimation strategy. Default is 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| anticipation         | how many periods before the treatment actually takes place that it can have an effect on outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| base_period          | The type of base period to use. This only affects the numeric value of results in pre-treatment periods. Results in post-treatment periods are not affected by this choice. The default is "varying", where the base period will "back up" to the immediately preceding period in pre-treatment periods. The other option is "universal" where the base period is fixed in pre-treatment periods to be the period right before the treatment starts. "Universal" is commonly used in difference-in-differences applications, but can be unnatural for other identification strategies. |
| cband                | whether or not to report a uniform (instead of pointwise) confidence band (default is TRUE)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| alp                  | significance level; default is 0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| boot_type            | which type of bootstrap to use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| weightsname          | The name of the column that contains sampling weights. The default is NULL, in which case no sampling weights are used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| gt_type              | which type of group-time effects are computed. The default is "att". Different estimation strategies can implement their own choices for gt_type                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ret_quantile         | For functions that compute quantile treatment effects, this is a specific quantile at which to report results, e.g., <code>ret_quantile = 0.5</code> will return that the qte at the median.                                                                                                                                                                                                                                                                                                                                                                                           |
| probs                | For <code>gt_type = "qtt"</code> , a numeric vector of quantile levels at which to evaluate the QTT curve (e.g., <code>seq(0.05, 0.95, 0.05)</code> ). Defaults to <code>seq(0.05, 0.95, 0.05)</code> when NULL.                                                                                                                                                                                                                                                                                                                                                                       |
| biters               | number of bootstrap iterations; default is 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| cl                   | number of clusters to be used when bootstrapping; default is 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| call                 | keeps track of through the call from external functions/packages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ...                  | additional arguments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Value**

pte\_params object

---

|                 |                             |
|-----------------|-----------------------------|
| setup_pte_basic | <i>Basic Setup Function</i> |
|-----------------|-----------------------------|

---

**Description**

This is a lightweight (example) function for how to setup the data to be used in the ptetools package.

setup\_pte\_basic takes in information about the structure of data and returns a pte\_params object. The key piece of information that is computed by this function is the list of groups and list of time periods where  $ATT(g,t)$  should be computed. In particular, this function omits the never-treated group but includes all other groups and drops the first time period. This setup is basically geared towards the 2x2 case — i.e., where ATT could be identified with two periods, a treated and untreated group, and the first period being pre-treatment for both groups. This is the relevant case for DID, but is also relevant for other cases as well. However, for example, if more pre-treatment periods were needed, then this function should be replaced by something else.

For code that is written with the idea of being easy-to-use by other researchers, this is a good place to do some error handling / checking that the data is in the correct format, etc.

**Usage**

```
setup_pte_basic(
  yname,
  gname,
  tname,
  idname = NULL,
  data,
  panel = TRUE,
  cband = TRUE,
  alp = 0.05,
  boot_type = "multiplier",
  gt_type = "att",
  ret_quantile = 0.5,
  probs = NULL,
  biters = 100,
  cl = 1,
  call = NULL,
  ...
)
```

**Arguments**

|       |                         |
|-------|-------------------------|
| yname | Name of outcome in data |
| gname | Name of group in data   |

|              |                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| tname        | Name of time period in data                                                                                                                                                     |
| idname       | Name of id in data                                                                                                                                                              |
| data         | balanced panel or repeated cross sections data                                                                                                                                  |
| panel        | Whether the data are panel data. The default is TRUE. Set to FALSE for repeated cross sections.                                                                                 |
| cband        | whether or not to report a uniform (instead of pointwise) confidence band (default is TRUE)                                                                                     |
| alp          | significance level; default is 0.05                                                                                                                                             |
| boot_type    | which type of bootstrap to use                                                                                                                                                  |
| gt_type      | which type of group-time effects are computed. The default is "att". Different estimation strategies can implement their own choices for gt_type                                |
| ret_quantile | For functions that compute quantile treatment effects, this is a specific quantile at which to report results, e.g., ret_quantile = 0.5 will return that the qte at the median. |
| probs        | For gt_type = "qtt", a numeric vector of quantile levels at which to evaluate the QTT curve (e.g., seq(0.05, 0.95, 0.05)). Defaults to seq(0.05, 0.95, 0.05) when NULL.         |
| biters       | number of bootstrap iterations; default is 100                                                                                                                                  |
| cl           | number of clusters to be used when bootstrapping; default is 1                                                                                                                  |
| call         | keeps track of through the call from external functions/packages                                                                                                                |
| ...          | additional arguments                                                                                                                                                            |

**Value**

pte\_params object

---

two\_by\_two\_rcs\_subset *Two Period Two Group Repeated Cross Sections Subset*

---

**Description**

A function for computing a 2x2 subset for repeated cross sections data. This is analogous to two\_by\_two\_subset, but indexes observations by rows rather than by panel ids.

**Usage**

```
two_by_two_rcs_subset(
  data,
  g,
  tp,
  control_group = "notyettreated",
  anticipation = 0,
  base_period = "varying",
  ...
)
```

**Arguments**

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>          | the full dataset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <code>g</code>             | the current group                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <code>tp</code>            | the current time period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <code>control_group</code> | whether to use "notyettreated" (default) or "nevertreated"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <code>anticipation</code>  | the number of periods of anticipation (i.e., number of periods before the treatment happens where the treatment can "already" affect the outcome)                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <code>base_period</code>   | The type of base period to use. This only affects the numeric value of results in pre-treatment periods. Results in post-treatment periods are not affected by this choice. The default is "varying", where the base period will "back up" to the immediately preceding period in pre-treatment periods. The other option is "universal" where the base period is fixed in pre-treatment periods to be the period right before the treatment starts. "Universal" is commonly used in difference-in-differences applications, but can be unnatural for other identification strategies. |
| <code>...</code>           | extra arguments to get the subset correct                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

**Value**

list that contains the following elements:

- `gt_data`: a `gt_data_frame` object that contains the correct subset of data
- `n1`: the number of observations in this subset
- `disidx`: a vector of the correct rows for this subset

---

|                                |                                    |
|--------------------------------|------------------------------------|
| <code>two_by_two_subset</code> | <i>Two Period Two Group Subset</i> |
|--------------------------------|------------------------------------|

---

**Description**

A function for computing a 2x2 subset of original data. This is the subset with post treatment periods separately for the treated group and comparison group and pre-treatment periods in the period immediately before the treated group became treated.

**Usage**

```
two_by_two_subset(
  data,
  g,
  tp,
  control_group = "notyettreated",
  anticipation = 0,
  base_period = "varying",
  ...
)
```

**Arguments**

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data          | the full dataset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| g             | the current group                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| tp            | the current time period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| control_group | whether to use "notyettreated" (default) or "nevertreated"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| anticipation  | the number of periods of anticipation (i.e., number of periods before the treatment happens where the treatment can "already" affect the outcome)                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| base_period   | The type of base period to use. This only affects the numeric value of results in pre-treatment periods. Results in post-treatment periods are not affected by this choice. The default is "varying", where the base period will "back up" to the immediately preceding period in pre-treatment periods. The other option is "universal" where the base period is fixed in pre-treatment periods to be the period right before the treatment starts. "Universal" is commonly used in difference-in-differences applications, but can be unnatural for other identification strategies. |
| ...           | extra arguments to get the subset correct                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

**Value**

list that contains the following elements:

- gt\_data: a gt\_data\_frame object that contains the correct subset of data
- n1: the number of observations in this subset
- disidx: a vector of the correct ids for this subset

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