

Package ‘psrwe’

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Title PS-Integrated Methods for Incorporating RWE in Clinical Studies

Version 3.1

Description High-quality real-world data can be transformed into scientific real-world evidence (RWE) for regulatory and healthcare decision-making using proven analytical methods and techniques. For example, propensity score (PS) methodology can be applied to pre-select a subset of real-world data containing patients that are similar to those in the current clinical study in terms of covariates, and to stratify the selected patients together with those in the current study into more homogeneous strata. Then, methods such as the power prior approach or composite likelihood approach can be applied in each stratum to draw inference for the parameters of interest. This package provides functions that implement the PS-integrated RWE analysis methods proposed in Wang et al. (2019) [<doi:10.1080/10543406.2019.1657133>](https://doi.org/10.1080/10543406.2019.1657133), Wang et al. (2020) [<doi:10.1080/10543406.2019.1684309>](https://doi.org/10.1080/10543406.2019.1684309) and Chen et al. (2020) [<doi:10.1080/10543406.2020.1730877>](https://doi.org/10.1080/10543406.2020.1730877).

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License GPL (≥ 3)

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R topics documented:

psrwe-package	3
ex_dta	4
ex_dta_rct	4
get_distance	5
plot.PSRWE_DTA	6
plot.PSRWE_DTA_MAT	6
plot.PSRWE_RST	7
print.PSRWE_BOR	7
print.PSRWE_DTA	8
print.PSRWE_DTA_MAT	8
print.PSRWE_RST	9
print.PSRWE_RST_OUTANA	9
psrwe_borrow	10
psrwe_ci	11
psrwe_compl	12
psrwe_est	13
psrwe_infer	14
psrwe_match	15
psrwe_outana	16
psrwe_powerp	18
psrwe_survkm	19
rwe_cl	20
rwe_cut	21
rwe_km	21
rwe_stan	22
summary.PSRWE_DTA	23
summary.PSRWE_DTA_MAT	24
summary.PSRWE_RST	25

Index

26

Description

This package provide R functions for conducting clinical studies with real-world evidence (RWE) incorporated in the study design and analysis.

PS-integrated power prior

We extend the Bayesian power prior approach for a single-arm study (the current study) to leverage external real-world data (RWD). We use propensity score methodology to pre-select a subset of real-world data containing patients that are similar to those in the current study in terms of covariates, and to stratify the selected patients together with those in the current study into more homogeneous strata. The power prior approach is then applied in each stratum to obtain stratum-specific posterior distributions, which are combined to complete the Bayesian inference for the parameters of interest.

PS-integrated composite likelihood

A propensity score-integrated composite likelihood (PSCL) approach is developed for cases in which the control arm of a two-arm randomized controlled trial (RCT) (treated vs. control) is augmented with patients from real-world data (RWD) containing both clinical outcomes and covariates at the patient-level. The PSCL approach first estimates the propensity score for every patient as the probability of the patient being in the RCT rather than the RWD, and then stratifies all patients into strata based on the estimated propensity scores. Within each propensity score stratum, a composite likelihood function is specified and utilized to down-weight the information contributed by the RWD source. Estimates of the stratum-specific parameters are obtained by maximizing the composite likelihood function. These stratum-specific estimates are then combined to obtain an overall population-level estimate of the parameter of interest.

References

- Chen WC, Wang C, Li H, Lu N, Tiwari R, Xu Y, Yue LQ. Propensity score-integrated composite likelihood approach for augmenting the control arm of a randomized controlled trial by incorporating real-world data. **Journal of Biopharmaceutical Statistics**. 2020; 30(3):508-520.
- Wang C, Lu N, Chen WC, Li H, Tiwari R, Xu Y, Yue LQ. Propensity score-integrated composite likelihood approach for incorporating real-world evidence in single-arm clinical studies. **Journal of Biopharmaceutical Statistics**. 2020; 30(3):495-507.
- Wang C, Li H, Chen WC, Lu N, Tiwari R, Xu Y, Yue LQ. Propensity score-integrated power prior approach for incorporating real-world evidence in single-arm clinical studies. **Journal of Biopharmaceutical Statistics**. 2019; 29(5):731-748.

ex_dta

Example dataset Example dataset of a single arm study.

Description

Example dataset

Example dataset of a single arm study.

Usage

```
data(ex_dta)
```

Format

A data frame with the following variables:

- Groupcurrent, rwd
- Y_BinBinary outcome
- Y_ConContinuous outcome
- Y_SurvSurvival outcome in days
- StatusEvent status (0=alive, 1=dead)
- V1-V7Covariates

ex_dta_rct

Example dataset Example dataset of a randomized study.

Description

Example dataset

Example dataset of a randomized study.

Usage

```
data(ex_dta_rct)
```

Format

A data frame with the following variables:

- Groupcurrent, rwd
- Armcontrol, treatment
- Y_ConContinuous outcome
- V1-V7Covariates

get_distance	<i>Distance between two distributions</i>
--------------	---

Description

Calculate difference measures using different metrics.

Usage

```
get_distance(  
  cov0,  
  cov1,  
  metric = c("ovl", "ksd", "astd", "std", "abd", "ley", "mhb", "omkss")  
)
```

Arguments

cov0	Vector (or matrix for metric = "mhb") of samples from the first distribution.
cov1	Vector (or matrix for metric = "mhb") of samples from the second distribution.
metric	Metric to use for calculating the distance with options: ovl Overlapping area(default) ksd Kullback-Leibler distance astd Standardized absolute mean difference std Standardized mean difference abd Absolute difference in means ley Levy distance mhb Mahalanobis distance omkss One minus Kolmogorov-Smirnov statistic

Value

A real value of the distance.

Examples

```
x <- rnorm(100, mean = 0, sd = 1)  
y <- rnorm(1000, mean = 1, sd = 2)  
get_distance(x, y, "ovl")  
get_distance(x, y, "abd")
```

plot.PSRWE_DTA *Plot PS distributions*

Description

S3 method for visualizing PS adjustment

Usage

```
## S3 method for class 'PSRWE_DTA'
plot(x, plot_type = c("ps", "balance", "diff"), ...)
```

Arguments

x	Class RWE_DWITHPS created by psrwe_* functions
plot_type	Types of plots. <ul style="list-style-type: none"> • psPS density plot • balanceCovariate balance plot • diffStandardized mean differences, metric = std or astd
...	Additional parameter for the plot

plot.PSRWE_DTA_MAT *Plot PS distributions*

Description

S3 method for visualizing PS adjustment based on matching.

Usage

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

Arguments

x	A list of class PSRWE_DTA_MAT that is generated using the psrwe_match function.
...	Parameters for plot.PSRWE_DTA

See Also

[plot.PSRWE_DTA](#)

plot.PSRWE_RST *Plot estimation results for power prior approach*

Description

S3 method plotting estimation results

Usage

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

Arguments

x A list of class PSRWE_RST that is generated using the [psrwe_powerp](#), [psrwe_compl](#),
or [psrwe_survkm](#) function.

... Additional parameters.

print.PSRWE_BOR *Print borrow information*

Description

Print summary information of borrowing

Usage

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

Arguments

x A list of class PSRWE_BOR that is generated using the [psrwe_borrow](#) function.

... Additional parameters

See Also

[psrwe_borrow](#)

`print.PSRWE_DTA` *Print PS estimation results*

Description

Print summary information of PS estimation results

Usage

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

Arguments

`x` A list of class `PSRWE_DTA` that is generated using the [psrwe_est](#) function.
`...` Parameters for `summary.PSRWE_DTA`

See Also

[summary.PSRWE_DTA](#)

`print.PSRWE_DTA_MAT` *Print PS estimation results*

Description

Print summary information of PS estimation results

Usage

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

Arguments

`x` A list of class `PSRWE_DTA_MAT` that is generated using the [psrwe_match](#) function.
`...` Additional parameters

See Also

[summary.PSRWE_DTA_MAT](#)

```
print.PSRWE_RST      Print estimation results
```

Description

Print summary information of outcome mean estimation results

Usage

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

Arguments

x	A list of class PSRWE_RST that is generated using the psrwe_powerp , psrwe_compl , or psrwe_survkm function.
...	Additional parameters

See Also

[summary.PSRWE_RST](#)

```
print.PSRWE_RST_OUTANA      Print outcome analysis results
```

Description

Print summary information of outcome analysis results

Usage

```
## S3 method for class 'PSRWE_RST_OUTANA'
print(x, show_details = FALSE, show_rct = FALSE, ...)
```

Arguments

x	A list of class PSRWE_RST_OUTANA that is generated using the psrwe_outana function.
show_details	print out more observed summary
show_rct	print out more analysis summary for RCT arms
...	Additional parameters

psrwe_borrow	<i>Get number of subjects borrowed from each stratum</i>
--------------	--

Description

Based on PS distances or number of current control subjects, split the total number of subjects to be borrowed from the external data source to each stratum

Usage

```
psrwe_borrow(
  dtaps,
  total_borrow,
  method = c("distance", "inverse_distance"),
  ...
)
```

Arguments

dtaps	A class PSRWE_DTA or PSRWE_DTA_MAT object.
total_borrow	Total number of subjects to be borrowed
method	Method to split total_borrow for a class PSRWE_DTA object, which can be based on distance (method = "distance") or inverse distance (method = "inverse_distance"). Ignored for class PSRWE_DTA_MAT object.
...	Additional parameters for summary.PSRWE_DTA .

Value

A class PSRWE_BORR list. It appends the following items to the dtaps:

- ProportionProportion splitting the number of total borrow among strata.
- N_BorrowThe number of to be borrowed subjects in each stratum.
- AlphaWeight parameter value in each stratum.

Examples

```
data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")

ps_borrow <- psrwe_borrow(total_borrow = 20, dta_ps)
ps_borrow

## Use different similarity metric
ps_borrow_omkss <- psrwe_borrow(total_borrow = 20, dta_ps,
```

```

                                metric = "omkss")
ps_borrow_omkss

```

psrwe_ci	<i>Confidence/Credible Interval for PS-Integrated Estimation Estimate the confidence/credible interval for the PS-integrated approach.</i>
----------	--

Description

Confidence/Credible Interval for PS-Integrated Estimation

Estimate the confidence/credible interval for the PS-integrated approach.

Usage

```

psrwe_ci(
  dta_psrst,
  method_ci = c("wald", "wilson"),
  conf_type = c("log_log", "plain"),
  conf_int = 0.95,
  ...
)

```

Arguments

dta_psrst	a returned object with class PSRWE_EST
method_ci	a method name for confidence interval (default Wald)
conf_type	a type name of transformation for the confidence interval of PSKM approach (default log_log)
conf_int	a two-sided level of confidence/credible limits (default 0.95)
...	other options

Details

method_ci = "wilson" is for binary outcomes only.

Value

A list with class name PSRWE_EST.

Examples

```

data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
ps_borrow <- psrwe_borrow(total_borrow = 30, dta_ps)
ps_rst <- psrwe_compl(ps_borrow, v_outcome = "Y_Con")
rst <- psrwe_ci(ps_rst)
rst

```

psrwe_compl

PS-Integrated Composite Likelihood Estimation

Description

Estimate the mean of the outcome based on PS-integrated composite likelihood approach. Variance is estimated by Jack-Knife method. Applies to the case when there is only one external data source.

Usage

```

psrwe_compl(
  dta_psbor,
  v_outcome = "Y",
  outcome_type = c("continuous", "binary"),
  ...
)

```

Arguments

dta_psbor	A class PSRWE_BOR object generated by psrwe_borrow .
v_outcome	Column name corresponding to the outcome.
outcome_type	Type of outcomes: continuous or binary.
...	Parameters for <code>rwe_cl</code>

Value

A data frame with class name PSRWE_RST. It contains the composite estimation of the mean for each stratum as well as the jackknife estimation for each subject. The results should be further summarized by its S3 method `summary`.

Examples

```

data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
ps_borrow <- psrwe_borrow(total_borrow = 30, dta_ps)
rst <- psrwe_compl(ps_borrow, v_outcome = "Y_Con")
rst

```

psrwe_est	<i>Estimate propensity scores</i>
-----------	-----------------------------------

Description

Estimate propensity scores using logistic regression or random forest model.

Usage

```

psrwe_est(
  data,
  ps_fm1 = NULL,
  ps_method = c("logistic", "randomforest"),
  v_covs = "V1",
  v_grp = "Group",
  cur_grp_level = 1,
  v_arm = NULL,
  ctl_arm_level = NULL,
  stra_ctl_only = TRUE,
  nstrata = 5,
  ...
)

```

Arguments

<code>data</code>	Data frame with group assignment and covariates.
<code>ps_fm1</code>	Propensity score (PS) formula. If NULL, all covariates will be included in the PS model in a linear form.
<code>ps_method</code>	Method to calculate propensity scores. Can be set to <code>logistic</code> for logistic regression or <code>randomforest</code> for a random forest approach.
<code>v_covs</code>	Column names corresponding to covariates.
<code>v_grp</code>	Column name corresponding to group assignment.
<code>cur_grp_level</code>	Group level for the current study. Default is <code>cur_grp_level = 1</code> . Ignored for single arm studies.
<code>v_arm</code>	Column name corresponding to arm assignment.

ctl_arm_level	Arm level for the control arm. Ignored for single-arm studies.
stra_ctl_only	Create strata by control arm patients only. Default TRUE. Ignored by single arm studies. For randomized studies, when stra_ctl_only is FALSE, strata are created based on the PS scores of the entire current study patients.
nstrata	Number of PS strata to be created.
...	Additional parameters for calculating the propensity score to be used in randomForest or glm.

Value

A list of class PSRWE_DAT with items:

- dataOriginal data with column `_ps_` for estimated PS scores and `_strata_` for PS stratum added.
- ps_fm1PS formula for estimated PS scores.
- is_rctWhether the current study is a randomized study.
- nstrataNumber of strata.

Examples

```
data(ex_dta)
psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
```

psrwe_infer	<i>Inference for the PS-Integrated Estimation Inference for the PS-integrated approach.</i>
-------------	---

Description

Inference for the PS-Integrated Estimation
 Inference for the PS-integrated approach.

Usage

```
psrwe_infer(dta_psrst, alternative = c("less", "greater"), mu = 0)
```

Arguments

dta_psrst	a returned object with class PSRWE_EST
alternative	a character string for the alternative hypothesis that must be one of "less" (default) or "greater"
mu	a number indicating the true value of the parameter of interest (or the difference in means for two arms)

Value

A list with class name PSRWE_EST.

Examples

```
data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
ps_borrow <- psrwe_borrow(total_borrow = 30, dta_ps)
ps_rst <- psrwe_compl(ps_borrow, v_outcome = "Y_Con")
rst <- psrwe_infer(ps_rst)
rst
```

psrwe_match

PS matching

Description

Match patients in external data source with patients in current study based on PS using nearest neighbor method.

Usage

```
psrwe_match(
  dta_ps,
  ratio = 3,
  strata_covs = NULL,
  caliper = 1,
  seed = NULL,
  method = c("nnwor", "optm"),
  ...
)
```

Arguments

dta_ps	A list of class PSRWE_DAT that is generated using the <code>psrwe_est</code> function.
ratio	Matching ratio (RWD : Current) with default value 3 meaning 3:1 matching.
strata_covs	Stratification covariates for matching.
caliper	PS matching caliper width. Default 1. This specifies a width (euclidean distance) on the probability scale.
seed	Random seed.
method	matching algorithm for PS matching.
...	Additional parameters for matching

Value

A list of class PSRWE_DTA_MAT with items:

- dataOriginal data with column `_ps_` for estimated PS scores, `match_id` for matched current study subject ID, and `_strata_` for PS stratum added.
- ps_fm1PS formula for estimated PS scores.
- nstrataNumber of strata.
- ratioMatching ratio.

Examples

```
data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
                   v_covs = paste("V", 1:7, sep = ""),
                   v_grp = "Group",
                   cur_grp_level = "current")
dta_ps_mat <- psrwe_match(dta_ps, ratio = 2, strata_covs = "V1",
                         seed = 123)
dta_ps_mat

## With optmatch
.remark_optmatch <- function() {
  warning("The optmatch package may restrict use (academic license).")
  dta_ps_opt <- psrwe_match(dta_ps, ratio = 2,
                           strata_covs = "V1",
                           method = "optm", seed = 123)
  dta_ps_opt
}
## Unmark below to run if optmatch is available.
# .remark_optmatch()
```

psrwe_outana

Outcome Analysis for PS-Integrated Estimation Report outcome analysis for the PS-integrated approach.

Description

Outcome Analysis for PS-Integrated Estimation
Report outcome analysis for the PS-integrated approach.

Usage

```
psrwe_outana(
  dta_psrst,
  method_ci = c("wald", "wilson"),
  conf_type = c("log_log", "plain"),
```



```

    conf_int = 0.95,
    alternative = c("less", "greater"),
    mu = 0,
    ...
  )

```

Arguments

<code>dta_psrst</code>	a returned object with class PSRWE_EST
<code>method_ci</code>	a method name for confidence interval (default Wald)
<code>conf_type</code>	a type name of transformation for the confidence interval of PSKM approach (default <code>log_log</code>)
<code>conf_int</code>	a two-sided level of confidence/credible limits (default 0.95)
<code>alternative</code>	a character string for the alternative hypothesis that must be one of "less" (default) or "greater"
<code>mu</code>	a number indicating the true value of the parameter of interest (or the difference in means for two arms)
<code>...</code>	other options

Details

This function is mainly for summarizing and reporting the outcome analysis for the PS-integrated estimation. The input `dta_psrst` can be generated from the functions [psrwe_powerp](#), [psrwe_compl](#), and [psrwe_survkm](#). See the functions [psrwe_ci](#) and [psrwe_infer](#) for the options of outcome analyses.

Value

A list with class name PSRWE_EST_OUTANA.

Examples

```

data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
ps_borrow <- psrwe_borrow(total_borrow = 30, dta_ps)
ps_rst <- psrwe_compl(ps_borrow, v_outcome = "Y_Con")
rst <- psrwe_outana(ps_rst)
rst

```

psrwe_powerp

Get posterior samples based on PS-power prior approach

Description

Draw posterior samples of the parameters of interest for the PS-power prior approach

Usage

```
psrwe_powerp(
  dta_psbor,
  v_outcome = "Y",
  outcome_type = c("continuous", "binary"),
  prior_type = c("fixed", "random"),
  ...,
  seed = NULL
)
```

Arguments

dta_psbor	A class PSRWE_BOR object generated by psrwe_borrow .
v_outcome	Column name corresponding to the outcome.
outcome_type	Type of outcomes: continuous or binary.
prior_type	Whether treat power parameter as fixed (fixed) or fully Bayesian (random).
...	extra parameters for calling function rwe_stan .
seed	Random seed.

Value

A class PSRWE_RST list with the following objects

Observed Observed mean and SD of the outcome by group, arm and stratum

Control A list of estimated mean and SD of the outcome by stratum in the control arm

Treatment A list of estimated mean and SD of the outcome by stratum in the treatment arm for RCT

Effect A list of estimated mean and SD of the treatment effect by stratum for RCT

Borrow Borrowing information from dta_psbor

stan_rst Result from STAN sampling

Examples

```
data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
ps_borrow <- psrwe_borrow(total_borrow = 30, dta_ps)
rst <- psrwe_powerp(ps_borrow, v_outcome = "Y_Con", seed = 123)
```

 psrwe_survkm

PS-Integrated Kaplan-Meier Estimation

Description

Estimate the mean of a survival outcome at a given time point based on PS-integrated Kaplan-Meier approach. Variance is estimated by Jack-Knife method. Applies to the case when there is only one external data source.

Usage

```
psrwe_survkm(dta_psbor, v_time = "time", v_event = "event", pred_tp = 1, ...)
```

Arguments

dta_psbor	A class PSRWE_BOR object generated by psrwe_borrow .
v_time	Column name corresponding to event time
v_event	Column name corresponding to event status
pred_tp	Time of interest (e.g., 1 year)
...	Additional Parameters.

Value

A data frame with class name PSRWE_RST. It contains the composite estimation of the mean for each stratum as well as the jackknife estimation. The results should be further summarized by its S3 method summary.

Examples

```
data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
  v_covs = paste("V", 1:7, sep = ""),
  v_grp = "Group",
  cur_grp_level = "current")
ps_borrow <- psrwe_borrow(total_borrow = 30, dta_ps)
```

```
rst      <- psrwe_survkm(ps_borrow,
                        v_time = "Y_Surv",
                        v_event = "Status")
rst
```

rwe_cl

Composite Likelihood Estimation

Description

Estimate parameter of interest based composite likelihood for a single PS stratum

Usage

```
rwe_cl(
  dta_cur,
  dta_ext,
  n_borrow = 0,
  outcome_type = c("continuous", "binary"),
  equal_sd = TRUE
)
```

Arguments

dta_cur	Vector of outcome from a PS stratum in current study
dta_ext	Vector of outcome from a PS stratum in external data source
n_borrow	Number of subjects to be borrowed
outcome_type	Type of outcomes: continuous or binary.
equal_sd	Boolean. whether sd is the same between the current study and external data source

Value

Maximum composite likelihood estimator of the mean

Examples

```
x <- rnorm(100, mean = 0, sd = 1)
y <- rnorm(1000, mean = 1, sd = 2)
rwe_cl(x, y, n_borrow = 20, equal_sd = FALSE)
```

rwe_cut	<i>Create strata</i>
---------	----------------------

Description

Cut a sequence of numbers into bins.

The cut points are chosen such that there will with equal numbers in each bin for x. By default, values of y that are outside the range of x will be excluded from the bins, unless they are in the keep_inx.

Usage

```
rwe_cut(x, y = x, breaks = 5, keep_inx = NULL)
```

Arguments

x	Vector of values based on which cut points will be determined
y	Vector of values to be cut, default to be the same as x
breaks	Number of cut points
keep_inx	Indices of y that will be categorized as 1 or the largest bin even if their values are out of range of x, i.e. the y's that will not be trimmed

Value

A vector of stratum assignment for y. The y's that are outside the range of x and not in keep_inx are assigned NA in the result.

Examples

```
x <- rnorm(100, mean = 0, sd = 1)
y <- rnorm(1000, mean = 1, sd = 2)
rwe_cut(x, y, breaks = 5)
```

rwe_km	<i>Kaplan-Meier Estimation</i>
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Description

Estimate survival probability based on Kaplan-Meier estimator for a single PS stratum

Usage

```
rwe_km(dta_cur, dta_ext = NULL, n_borrow = 0, pred_tp = 1)
```

Arguments

dta_cur	Matrix of time and event from a PS stratum in current study
dta_ext	Matrix of time and event from a PS stratum in external data source
n_borrow	Number of subjects to be borrowed
pred_tp	Time points to be estimated

Value

Estimation of survival probabilities at time pred_tps

rwe_stan	<i>Call STAN models</i>
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Description

Call STAN models. Called by psrwe_powerp.

Usage

```
rwe_stan(
  lst_data,
  stan_md1 = c("powerps", "powerpsbinary", "powerp"),
  chains = 4,
  iter = 2000,
  warmup = 1000,
  control = list(adapt_delta = 0.95),
  ...
)
```

Arguments

lst_data	List of study data to be passed to STAN
stan_md1	STAN model including powerps PS-power prior model for continuous outcomes powerpsbinary PS-power prior model for binary outcomes powerp Power prior model
chains	STAN parameter. Number of Markov chains
iter	STAN parameter. Number of iterations
warmup	STAN parameter. Number of burnin.
control	STAN parameter. See <code>rstan::stan</code> for details.
...	other options to call STAN sampling such as <code>thin</code> , <code>algorithm</code> . See <code>rstan::sampling</code> for details. [#]

Value

Result from STAN sampling

summary.PSRWE_DTA *Summarize PS estimation and stratification results*

Description

Get number of subjects and the distances of PS distributions for each PS stratum.

Usage

```
## S3 method for class 'PSRWE_DTA'
summary(
  object,
  metric = c("ovl", "ksd", "std", "abd", "ley", "mhb", "omkss"),
  min_n0 = 10,
  ...
)
```

Arguments

object	A list of class PSRWE_DAT that is generated using the psrwe_est function.
metric	Metric to use for calculating the distance with options: ovl Overlapping area(default) ksd Kullback-Leibler distance astd Standardized absolute mean difference std Standardized mean difference abd Absolute difference in means ley Levy distance mhb Mahalanobis distance omkss One minus Kolmogorov-Smirnov statistic
min_n0	threshold for number of external subjects, below which the external data in the current stratum will be ignored by setting the PS distance to 0. Default value 10.
...	Additional parameters.

Value

A list with columns:

- SummaryA data frame with Stratum, number of subjects in RWD, current study, number of subjects in control and treatment arms for RCT studies, and distance in PS distributions.
- OverallA data frame with overall number of not-trimmed subjects in RWD, number of patients in current study, number of subjects in control and treatment arms for RCT studies, and distance in PS distributions.
- NVector of total number of total RWD patients, number of trimmed RWD patients, and total number of current study patients.
- ps_fm1PS model.
- Distance_metricMetric used for calculating the distance.

Examples

```

data(ex_dta)
dta_ps <- psrwe_est(ex_dta,
                   v_covs = paste("V", 1:7, sep = ""),
                   v_grp = "Group",
                   cur_grp_level = "current")

dta_ps

## With different similarity metric
print(dta_ps, metric = "omkss")
dta_ps_sum <- summary(dta_ps, metric = "omkss")

```

summary.PSRWE_DTA_MAT *Summarize PS estimation and matching results*

Description

Get number of subjects for each PS stratum.

Usage

```

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

```

Arguments

object	A list of class PSRWE_DTA_MAT that is generated using the psrwe_match function.
...	Additional parameters.

Value

A list with columns:

- SummaryA data frame with Stratum (defined by covariates), number of subjects in RWD, current study, number of subjects in control and treatment arms for RCT studies.
- OverallA data frame with overall number of not-trimmed subjects in RWD, number of patients in current study, number of subjects in control and treatment arms for RCT studies.
- NVector of total number of total RWD patients, number of trimmed RWD patients, total number of current study patients, number of current control patients with less than `ratio` matched RWD subjects.
- ps_fmIPS model.
- N_MatchNumber of current control subjects matched with `ratio`, 0 and other number of RWD subjects.
- ratioMatching ratio.

summary.PSRWE_RST	<i>Summarize overall estimation results</i>
-------------------	---

Description

S3 method summarizing overall estimation results

Usage

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

Arguments

object	A list of class PSRWE_RST that is generated using the psrwe_powerp , psrwe_comp1 , or psrwe_survkm function.
...	Additional parameters.

Value

A list with data frames for the borrowing and estimation results.

Index

* datasets

ex_dta, 4
ex_dta_rct, 4

ex_dta, 4
ex_dta_rct, 4

get_distance, 5

plot.PSRWE_DTA, 6, 6
plot.PSRWE_DTA_MAT, 6
plot.PSRWE_RST, 7
print.PSRWE_BOR, 7
print.PSRWE_DTA, 8
print.PSRWE_DTA_MAT, 8
print.PSRWE_RST, 9
print.PSRWE_RST_OUTANA, 9
psrwe (psrwe-package), 3
psrwe-package, 3
psrwe_borrow, 7, 10, 12, 18, 19
psrwe_ci, 11, 17
psrwe_compl, 7, 9, 12, 17, 25
psrwe_est, 8, 13, 15, 23
psrwe_infer, 14, 17
psrwe_match, 6, 8, 15, 24
psrwe_outana, 9, 16
psrwe_powerp, 7, 9, 17, 18, 25
psrwe_survkm, 7, 9, 17, 19, 25

rwe_cl, 20
rwe_cut, 21
rwe_km, 21
rwe_stan, 18, 22

summary.PSRWE_DTA, 8, 10, 23
summary.PSRWE_DTA_MAT, 8, 24
summary.PSRWE_RST, 9, 25