Package 'drord'

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Title Doubly-Robust Estimators for Ordinal Outcomes

Version 1.0.1

Description Efficient covariate-adjusted estimators of quantities that are useful for establishing the effects of treatments on ordinal outcomes.

Depends R (>= 3.5.0)

Imports MASS, VGAM, ordinal, ggplot2

Suggests testthat, knitr, rmarkdown, ggsci

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URL https://github.com/benkeser/drord

BugReports https://github.com/benkeser/drord/issues

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VignetteBuilder knitr

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Repository CRAN

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Contents

`bca_interval` *Compute a BCa confidence interval*

Description

Compute a BCa confidence interval

Usage

```
bca_interval(pt_est, boot_samples, jack_samples, alpha = 0.05)
```

Arguments

`pt_est`	The point estimate of the parameter of interest
`boot_samples`	A collection of bootstrap realizations of the estimator of the parameter of interest
`jack_samples`	A vector of jackknife estimates of the parameter of interest.
`alpha`	Confidence intervals have nominal level 1-`alpha`.

Value

2-length vector containing BCa confidence interval limits.

`bca_logodds` *Compute a BCa bootstrap confidence interval for the weighted mean. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf*

Description

Compute a BCa bootstrap confidence interval for the weighted mean. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf

Usage

```
bca_logodds(
  treat,
  covar,
  out,
  nboot,
  treat_form,
  out_levels,
  out_form,
  out_model,
  logodds_est,
  alpha = 0.05
)
```

Arguments

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
logodds_est	The estimated log-odds.
alpha	Level of confidence interval.

Value

matrix with treatment-specific log-odds CIs and CI for difference.

---

bca_mannwhitney *Compute a BCa bootstrap confidence interval for the Mann-Whitney parameter. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf*

Description

Compute a BCa bootstrap confidence interval for the Mann-Whitney parameter. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf

Usage

```
bca_mannwhitney(
  treat,
  covar,
  out,
  nboot,
  treat_form,
  out_levels,
  out_form,
  mannwhitney_est,
  out_model,
  alpha = 0.05
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Missing values are not allowed unless the corresponding entry in `out` is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`nboot`	Number of bootstrap replicates used to compute bootstrap confidence intervals.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
`mannwhitney_est`	The point estimate of the Mann-Whitney parameter.
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).
`alpha`	Level of confidence interval.

Value

Confidence interval for the Mann-Whitney parameter

bca_marg_dist *Compute a BCa bootstrap confidence interval for the weighted mean. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf*

Description

Compute a BCa bootstrap confidence interval for the weighted mean. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf

Usage

```
bca_marg_dist(
  treat,
  covar,
  out,
  nboot,
  treat_form,
  out_levels,
  out_form,
  out_model,
  marg_cdf_est,
  marg_pmf_est,
  alpha = 0.05
)
```

Arguments

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
marg_cdf_est	Point estimate of treatment-specific CDF.
marg_pmf_est	Point estimate of treatment-specific PMF.
alpha	Level of confidence interval.

Value

List (`cdf`, `pmf`) of lists (`treat=1`, `treat=0`) of confidence intervals for distributions.

`bca_wmean` *Compute a BCa bootstrap confidence interval for the weighted mean. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf*

Description

Compute a BCa bootstrap confidence interval for the weighted mean. The code is based on the slides found here: http://users.stat.umn.edu/~helwig/notes/bootci-Notes.pdf

Usage

```
bca_wmean(
  treat,
  covar,
  out,
  nboot,
  treat_form,
  out_levels,
  out_form,
  out_weights,
  out_model,
  wmean_est,
  alpha = 0.05
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Missing values are not allowed unless the corresponding entry in `out` is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`nboot`	Number of bootstrap replicates used to compute bootstrap confidence intervals.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.

out_weights	A vector of numeric weights with length equal to the length of out_levels.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
wmean_est	The estimated weighted means + estimated covariance matrix.
alpha	Level of confidence interval.

Value

matrix with treatment-specific weighted mean CIs and CI for difference.

---

compute_trt_spec_bca_intervals

Used to compute treatment-specific BCa intervals for the CDF and PMF

Description

Used to compute treatment-specific BCa intervals for the CDF and PMF

Usage

```
compute_trt_spec_bca_intervals(
  dist = c("cdf", "pmf"),
  trt = c(1, 0),
  marg_est,
  boot_samples,
  jack_samples,
  alpha
)
```

Arguments

dist	Which one? CDF or PMF?
trt	Which treatment?
marg_est	The point estimate
boot_samples	A collection of bootstrap realizations of the estimator of the parameter of interest
jack_samples	A vector of jackknife estimates of the parameter of interest.
alpha	Confidence intervals have nominal level 1-alpha.

Value

List of pointwise and simultaneous confidence intervals for dist.

compute_trt_spec_marg_dist_ptwise_ci

Compute simultaneous confidence interval for treatment-specific marginal distribution

Description

Compute simultaneous confidence interval for treatment-specific marginal distribution

Usage

```
compute_trt_spec_marg_dist_ptwise_ci(pt_est, cov_est, alpha, cdf = TRUE)
```

Arguments

pt_est	The point estimate of the treatment-specific marginal CDF/PMF
cov_est	Covariance matrix estimates.
alpha	Confidence intervals have nominal level 1-alpha.
cdf	Is this for CDF or PMF?

Value

Confidence interval

compute_trt_spec_marg_dist_simul_ci

Compute simultaneous confidence interval for treatment-specific marginal distribution

Description

Compute simultaneous confidence interval for treatment-specific marginal distribution

Usage

```
compute_trt_spec_marg_dist_simul_ci(
  pt_est,
  trt_spec_marg_dist_eif,
  remove_last = TRUE,
  alpha
)
```

Arguments

`pt_est`	The point estimate of the treatment-specific marginal CDF/PMF
`trt_spec_marg_dist_eif`	The EIF estimates for the treatment-specific marginal CDF/PMF estimates
`remove_last`	Should the last level be removed? Should be set equal to `TRUE` for CDF computations and `FALSE` for PMF computations.
`alpha`	Confidence intervals have nominal level 1-`alpha`.

Value

Confidence interval

`covid19` *Simulated COVID-19 outcomes for hospitalized patients.*

Description

A simulated dataset containing outcomes, (hypothetical) treatment, and age group

Usage

```
covid19
```

Format

A data frame with 500 rows and 3 variables:

out study outcome, here 1 represents death, 2 intubation, 3 no adverse outcome

age_grp age category with 1 the youngest and 7 the oldest

treat hypothetical treatment, here 1 represents an (effective) active treatment and 0 a control

---

`drord` *Doubly robust estimates of for evaluating effects of treatments on ordinal outcomes.*

Description

The available parameters for evaluating treatment efficacy are:

- Difference in (weighted) means: The outcome levels are treated numerically, with each level possibly assigned a weight. The difference in average outcomes is computed.
- Log odds ratio: The comparison describes the average log-odds (treatment level 1 versus 0) of the cumulative probability for each level of the outcome.
- Mann-Whitney: The probability that a randomly-selected individual receiving treatment 1 will have a larger outcome value than a randomly selected individual receiving treatment 0 (with ties assigned weight 1/2).

Usage

```
drord(
  out,
  treat,
  covar,
  out_levels = sort(unique(out)),
  out_form = paste0(colnames(covar), collapse = "+"),
  out_weights = rep(1, length(out_levels)),
  out_model = "pooled-logistic",
  treat_form = "1",
  param = c("weighted_mean", "log_odds", "mann_whitney"),
  ci = "wald",
  alpha = 0.05,
  nboot = 1000,
  return_models = TRUE,
  est_dist = TRUE,
  stratify = FALSE,
  ...
)
```

Arguments

out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_weights	A vector of numeric weights with length equal to the length of out_levels.
out_model	Which R function should be used to fit the proportional odds model. The recommended option is "pooled-logistic". Other options available include "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
param	A vector of characters indicating which of the three treatment effect parameters should be estimated ("weighted_mean", "log_odds", and/or "mann_whitney").
ci	A vector of characters indicating which confidence intervals should be computed ("bca" and/or "wald")
alpha	Confidence intervals have nominal level 1-alpha.

nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.
return_models	If TRUE the fitted working proportional odds models and treatment probability models are returned.
est_dist	A boolean indicating whether estimates of the CDF and PMF should be computed and returned. For real data analysis, we generally recommend leaving as TRUE; however, when studying performance in simulations, it can save time to set to FALSE.
stratify	If TRUE, then a fully stratified estimator is computed, i.e., the empirical CDF of each treatment arm is estimated stratifying by levels of covar. For now, this option is limited to univariate covariates.
...	Other options (not currently used).

Details

In each case, estimates are constructed by obtaining a doubly robust estimate of the cumulative distribution function (CDF) for each treatment group. This is achieved by fitting a (working) proportional odds model that includes inverse probability of treatment weights. The inclusion of these weights ensures that, so long as the working model includes intercept terms, the resultant estimate of the CDF is an augmented inverse probability of treatment weighted estimate. This implies that the estimate is nonparametric efficient if the working model contains the truth; however, even if the working model does not contain the truth, the CDF estimates are consistent and asymptotically normal with variance expected to dominate that of an unadjusted estimate of the same treatment effect.

The CDF estimates are subsequently mapped into estimates of each requested parameter for evaluating treatment effects. The double robustness and efficiency properties of the CDF estimates extend to these quantities as well. Confidence intervals and hypothesis tests can be carried out in closed form using Wald-style intervals and tests or using a nonparametric corrected and accelerated bootstrap (BCa). Inference for the CDF and probability mass function is also returned and can be used for subsequent visualizations (see plot.drord).

Value

An object of class drord. In addition to information related to how drord was called, the output contains the following:

log_odds inference pertaining to the log-odds parameter. NULL if this parameter not requested in call to drord.

mann_whitney inference pertaining to the Mann-Whitney parameter. NULL if this parameter not requested in call to drord.

weighted_mean inference pertaining to weighted mean parameter. NULL if this parameter not requested in call to drord.

cdf inference pertaining to the treatment-specific CDFs. See the plot method for a convenient way of visualizing this information. NULL if est_dist = FALSE in call to drord.

pmf inference pertaining to the treatment-specific PMFs. See the plot method for a convenient way of visualizing this information. NULL if est_dist = FALSE in call to drord.

treat_mod the fitted model for the probability of treatment as a function of covariates. NULL if return_models = FALSE

out_mod the proportional odds model fit in each treatment arm. named entries in list indicate the corresponding treatment arm. NULL if `return_models` = FALSE or `stratify` = TRUE.

Examples

```
data(covid19)

# get estimates of all parameters based on main-effects
# proportional odds model and intercept-only propensity model
fit <- drord(out = covid19$out, treat = covid19$treat,
             covar = covid19[, "age_grp", drop = FALSE])

# get estimates of all parameters based on proportional odds and
# propensity model that treats age_grp as categorical
fit2 <- drord(out = covid19$out, treat = covid19$treat,
              covar = covid19[, "age_grp", drop = FALSE],
 out_form = "factor(age_grp)",
 treat_form = "factor(age_grp)")

# obtain estimator stratified by age group
fit3 <- drord(out = covid19$out, treat = covid19$treat,
              covar = covid19[, "age_grp", drop = FALSE],
 stratify = TRUE)

# demonstration with missing outcome data
covid19$out[1:5] <- NA

# propensity model should now adjust for covariates to address
# the potential for informative missingness
fit4 <- drord(out = covid19$out, treat = covid19$treat,
              covar = covid19[, "age_grp", drop = FALSE],
 treat_form = "age_grp")
```

`eif_pmf_k` *Get EIF estimates for treatment-specific PMF at a particular level of the outcome*

Description

Get EIF estimates for treatment-specific PMF at a particular level of the outcome

Usage

```
eif_pmf_k(k, out, treat, trt_level, trt_spec_prob_est, trt_k_spec_pmf_est)
```

Arguments

k	The level of the outcome.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
trt_level	Treatment level
trt_spec_prob_est	Estimated propensity for trt_level.
trt_k_spec_pmf_est	Estimated conditional PMF for trt_level at k.

`eif_theta_k` *Get EIF estimates for treatment-specific CDF at a particular level of the outcome*

Description

Get EIF estimates for treatment-specific CDF at a particular level of the outcome

Usage

```
eif_theta_k(k, out, treat, trt_level, trt_spec_prob_est, trt_k_spec_cdf_est)
```

Arguments

k	The level of the outcome.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
trt_level	Treatment level
trt_spec_prob_est	Estimated propensity for trt_level.
trt_k_spec_cdf_est	Estimated conditional CDF for trt_level at k.

`estimate_cdf` *Map an estimate of the conditional PMF into an estimate of the conditional CDF*

Description

Map an estimate of the conditional PMF into an estimate of the conditional CDF

Usage

```
estimate_cdf(pmf_est)
```

Arguments

pmf_est	A list of the treatment-specific PMF estimates

Value

A list of treatment-specific CDF estimates

---

estimate_ci_logodds *Compute confidence interval/s for the log-odds parameters*

Description

Compute confidence interval/s for the log-odds parameters

Usage

```
estimate_ci_logodds(
  logodds_est,
  cdf_est,
  out_form,
  covar,
  treat_prob_est,
  treat,
  treat_form,
  out,
  ci,
  alpha = 0.05,
  nboot,
  out_levels,
  out_model,
  ...
)
```

Arguments

logodds_est	The point estimates for log-odds.
cdf_est	A list of treatment-specific CDF estimates.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
covar	A data.frame containing the covariates to include in the working proportional odds model.
treat_prob_est	Estimated probability of treatments, output from call to estimate_treat_prob.
treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.

treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
ci	A vector of characters indicating which confidence intervals should be computed ("bca" and/or "wald")
alpha	Confidence intervals have nominal level 1-alpha.
nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.
out_levels	A numeric vector containing all ordered levels of the outcome.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
...	Other options (not currently used).

Value

List with wald and bca-estimated confidence intervals for the weighted mean parameters.

`estimate_ci_mannwhitney` *Compute confidence interval/s for the Mann-Whitney parameter*

Description

Compute confidence interval/s for the Mann-Whitney parameter

Usage

```
estimate_ci_mannwhitney(
  mannwhitney_est,
  cdf_est,
  pmf_est,
  treat_prob_est,
  treat_form,
  out_form,
  treat,
  ci,
  out,
  alpha,
  nboot,
  out_levels,
  covar,
  out_model
)
```

Arguments

mannwhitney_est	The point estimates for log-odds.
cdf_est	The estimated conditional CDF.
pmf_est	The estimated conditional PMF.
treat_prob_est	Estimated probability of treatments, output from call to estimate_treat_prob.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
ci	A vector of characters indicating which confidence intervals should be computed ("bca" and/or "wald")
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
alpha	Confidence intervals have nominal level 1-alpha.
nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.
out_levels	A numeric vector containing all ordered levels of the outcome.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).

Value

List with wald and bca-estimated confidence intervals for the Mann-Whitney parameter.

---

estimate_ci_marg_dist *Compute confidence interval/s for the treatment specific PMF and CDF.*

Description

Compute confidence interval/s for the treatment specific PMF and CDF.

Usage

```
estimate_ci_marg_dist(
  marg_cdf_est,
  marg_pmf_est,
  cdf_est,
  pmf_est,
  covar,
  treat_prob_est,
  treat_form,
  out_form,
  treat,
  ci,
  out_levels,
  out_model,
  out,
  alpha,
  nboot
)
```

Arguments

marg_cdf_est	Point estimate of treatment-specific CDF.
marg_pmf_est	Point estimate of treatment-specific PMF.
cdf_est	Estimates of treatment-specific conditional CDF.
pmf_est	Estimates of treatment-specific conditional PMF.
covar	A data.frame containing the covariates to include in the working proportional odds model.
treat_prob_est	Estimated probability of treatments, output from call to estimate_treat_prob.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
ci	A vector of characters indicating which confidence intervals should be computed ("bca" and/or "wald")
out_levels	A numeric vector containing all ordered levels of the outcome.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
alpha	Confidence intervals have nominal level 1-alpha.
nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.

Value

List of lists (cdf and pmf) with wald and bca-estimated confidence intervals for the marginal treatment-specific distribution functions.

`estimate_ci_wmean` *Compute confidence interval/s for the weight mean parameters*

Description

Compute confidence interval/s for the weight mean parameters

Usage

```
estimate_ci_wmean(
  out,
  treat,
  covar,
  wmean_est,
  alpha = 0.05,
  out_levels = order(unique(out)),
  out_form = NULL,
  out_weights = rep(1, length(out_levels)),
  out_model,
  treat_form = "1",
  ci = c("bca", "wald"),
  nboot = 10000
)
```

Arguments

out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
covar	A data.frame containing the covariates to include in the working proportional odds model.
wmean_est	The point estimates for weighted means
alpha	Confidence intervals have nominal level 1-alpha.
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_weights	A vector of numeric weights with length equal to the length of out_levels.

out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
ci	A vector of characters indicating which confidence intervals should be computed ("bca" and/or "wald")
nboot	Number of bootstrap replicates used to compute bootstrap confidence intervals.

Value

List with wald and bca-estimated confidence intervals for the weighted mean parameters.

---

estimate_cond_mean *Map an estimate of treatment-specific PMF into an estimate of treatment specific conditional mean for each observation.*

Description

Map an estimate of treatment-specific PMF into an estimate of treatment specific conditional mean for each observation.

Usage

```
estimate_cond_mean(trt_spec_pmf_est, ordered_out_levels, ordered_out_weights)
```

Arguments

trt_spec_pmf_est	The treatment-specific PMF estimates
ordered_out_levels	Self explanatory
ordered_out_weights	Self explanatory

Value

Vector of estimated conditional means

estimate_eif_wmean *Obtain an estimate of the efficient influence function for the treatment-specific weighted mean parameter*

Description

Obtain an estimate of the efficient influence function for the treatment-specific weighted mean parameter

Usage

```
estimate_eif_wmean(
  trt_spec_cond_mean_est,
  trt_spec_prob_est,
  trt_level,
  out,
  treat
)
```

Arguments

trt_spec_cond_mean_est	Conditional mean for trt_level
trt_spec_prob_est	Propensity for trt_level
trt_level	Treatment level
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.

estimate_logodds *implements a plug-in estimator of equation (2) in Diaz et al*

Description

implements a plug-in estimator of equation (2) in Diaz et al

Usage

```
estimate_logodds(cdf_est)
```

Arguments

cdf_est	A list of treatment-specific CDF estimates

Value

Log odds of treatment = 1, = 0, and the difference.

---

estimate_mannwhitney *Compute the estimate of Mann-Whitney based on conditional CDF and PMF*

Description

Compute the estimate of Mann-Whitney based on conditional CDF and PMF

Usage

```
estimate_mannwhitney(cdf_est, pmf_est)
```

Arguments

cdf_est	Conditional CDF estimates
pmf_est	Conditional PMF estimates

Value

Mann-Whitney point estimate

---

estimate_pmf *Get a treatment-specific estimate of the conditional PMF. Essentially this is a wrapper function for* fit_trt_spec_reg*, which fits the proportion odds model in a given treatment arm.*

Description

Get a treatment-specific estimate of the conditional PMF. Essentially this is a wrapper function for fit_trt_spec_reg, which fits the proportion odds model in a given treatment arm.

Usage

```
estimate_pmf(
  out,
  treat,
  covar,
  out_levels,
  out_form = NULL,
  out_model,
  treat_prob_est,
  stratify = FALSE,
  return_models = TRUE,
  ...
)
```

Arguments

out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
treat_prob_est	Estimated probability of treatments, output from call to estimate_treat_prob.
stratify	Boolean indicating whether to use nonparametric maximum likelihood (i.e., a stratified estimator). If out_form = "1", then a covariate-unadjusted estimate is computed.
return_models	If TRUE the fitted working proportional odds models and treatment probability models are returned.
...	Other options (not used).

Value

A list with fm the fitted model for treatment 1 and 0 (or, if !return_models then NULL) and pmf the estimated PMF under treatment 1 and 0 evaluated on each observation.

`estimate_treat_prob` *Estimate probability of receiving each level of treatment*

Description

Estimate probability of receiving each level of treatment

Usage

```
estimate_treat_prob(treat, covar, treat_form, return_models)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`return_models`	If `TRUE` the fitted working proportional odds models and treatment probability models are returned.

Value

A list where the first element is estimate of Pr(`treat` = 1 | `covar`) for `covar` equal to inputted values of `covar` and second element is estimate of Pr(`treat` = 0 | `covar`) for `covar` equal to inputted values of `covar`

`estimate_wmean` *Compute the estimate of the weighted mean parameter based on estimated PMF in each treatment arm.*

Description

Compute the estimate of the weighted mean parameter based on estimated PMF in each treatment arm.

Usage

```
estimate_wmean(
  pmf_est,
  treat,
  out,
  out_levels,
  out_weights,
  treat_prob_est,
  return_cov = TRUE
)
```

Arguments

pmf_est	List of treatment-specific PMF estimates.
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
out_levels	A numeric vector containing all ordered levels of the outcome.
out_weights	A vector of numeric weights with length equal to the length of out_levels.
treat_prob_est	Estimated probability of treatments, output from call to estimate_treat_prob.
return_cov	If TRUE the estimated covariance matrix is returned.

Value

List with estimates of treatment-specific means and difference in means. If return_cov = TRUE, also includes covariance matrix estimates.

---

evaluate_beta_cov *Get the covariance matrix for beta*

Description

Get the covariance matrix for beta

Usage

```
evaluate_beta_cov(cdf_est, theta_cov)
```

Arguments

cdf_est	Estimated CDFs
theta_cov	Covariance matrix for CDF estimates

Value

Estimated covariance matrix for log-odds ratio parameters

`evaluate_mannwhitney_gradient` *Compute the estimated gradient of the Mann-Whitney parameter. Needed to derive standard error for Wald confidence intervals.*

Description

Compute the estimated gradient of the Mann-Whitney parameter. Needed to derive standard error for Wald confidence intervals.

Usage

```
evaluate_mannwhitney_gradient(cdf_est, pmf_est)
```

Arguments

`cdf_est`	Conditional CDF estimates
`pmf_est`	Conditional PMF estimates

Value

3-length vector for delta method calculus

`evaluate_marg_cdf_eif` *Get eif estimates for treatment-specific CDF*

Description

Get eif estimates for treatment-specific CDF

Usage

```
evaluate_marg_cdf_eif(cdf_est, treat_prob_est, treat, out, out_levels)
```

Arguments

`cdf_est`	Estimated conditional CDF for `trt_level`.
`treat_prob_est`	Estimated propensity for `trt_level`.
`treat`	A `numeric` vector containing treatment status. Should only assume a value 0 or 1.
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.

Value

a list of eif estimates

`evaluate_marg_cdf_ptwise_ci` *Evaluate pointwise confidence interval for marginal CDF.*

Description

Evaluate pointwise confidence interval for marginal CDF.

Usage

```
evaluate_marg_cdf_ptwise_ci(marg_cdf_est, marg_cdf_eif, alpha)
```

Arguments

`marg_cdf_est`	The point estimate of the marginal CDF distribution
`marg_cdf_eif`	The EIF estimates for the marginal CDF estimates
`alpha`	Confidence intervals have nominal level 1-`alpha`.

Value

List by treatment of simultaneous confidence intervals

`evaluate_marg_dist_simul_ci` *Evaluate simultaneous confidence interval for marginal PMF or CDF.*

Description

Evaluate simultaneous confidence interval for marginal PMF or CDF.

Usage

```
evaluate_marg_dist_simul_ci(
  marg_dist_est,
  marg_dist_eif,
  alpha,
  remove_last = FALSE
)
```

Arguments

marg_dist_est	The point estimate of the marginal CDF/PMF distribution
marg_dist_eif	The EIF estimates for the marginal CDF/PMF estimates
alpha	Confidence intervals have nominal level 1-alpha.
remove_last	Should the last level be removed? Should be set equal to TRUE for CDF computations and FALSE for PMF computations.

Value

List by treatment of simultaneous confidence intervals

---

evaluate_marg_pmf_eif *Get eif estimates for treatment-specific PMF*

Description

Get eif estimates for treatment-specific PMF

Usage

```
evaluate_marg_pmf_eif(pmf_est, treat_prob_est, treat, out, out_levels)
```

Arguments

pmf_est	Estimated conditional PMF for trt_level.
treat_prob_est	Estimated propensity for trt_level.
treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
out_levels	A numeric vector containing all ordered levels of the outcome.

Value

a list of eif estimates

evaluate_marg_pmf_ptwise_ci *Evaluate pointwise confidence interval for marginal PMF.*

Description

Evaluate pointwise confidence interval for marginal PMF.

Usage

```
evaluate_marg_pmf_ptwise_ci(marg_pmf_est, marg_pmf_eif, alpha)
```

Arguments

marg_pmf_est	The point estimate of the marginal PMF distribution
marg_pmf_eif	The EIF estimates for the marginal PMF estimates
alpha	Confidence intervals have nominal level 1-alpha.

Value

List by treatment of simultaneous confidence intervals

evaluate_theta_cov *get a covariance matrix for the estimated CDF*

Description

get a covariance matrix for the estimated CDF

Usage

```
evaluate_theta_cov(cdf_est, treat_prob_est, treat, out, out_levels)
```

Arguments

cdf_est	The estimates of the treatment-specific CDFs
treat_prob_est	List of estimated probability of treatments, output from call to estimate_treat_prob.
treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
out_levels	A numeric vector containing all ordered levels of the outcome.

Value

Estimated covariance matrix for CDF estimates

`evaluate_trt_spec_pmf_eif` *Get a matrix of eif estimates for treatment-specific PMF*

Description

Get a matrix of eif estimates for treatment-specific PMF

Usage

```
evaluate_trt_spec_pmf_eif(
  trt_spec_pmf_est,
  trt_spec_prob_est,
  trt_level,
  treat,
  out,
  out_levels
)
```

Arguments

`trt_spec_pmf_est`	Estimated conditional PMF for `trt_level`.
`trt_spec_prob_est`	Estimated propensity for `trt_level`.
`trt_level`	Treatment level
`treat`	A `numeric` vector containing treatment status. Should only assume a value 0 or 1.
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.

Value

a matrix of EIF estimates

`evaluate_trt_spec_theta_eif` *get a matrix of eif estimates for the treatment-specific CDF estimates*

Description

get a matrix of eif estimates for the treatment-specific CDF estimates

Usage

```
evaluate_trt_spec_theta_eif(
  trt_spec_cdf_est,
  trt_spec_prob_est,
  trt_level,
  treat,
  out,
  out_levels
)
```

Arguments

trt_spec_cdf_est	Estimated conditional CDF for trt_level.
trt_spec_prob_est	Estimated propensity for trt_level.
trt_level	Treatment level
treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
out_levels	A numeric vector containing all ordered levels of the outcome.

Value

matrix of EIF estimates for CDF.

---

fit_trt_spec_reg *Helper function to fit a treatment specific outcome regression. If there are more than 2 observed levels of the outcome for the specified treatment arm, then* polr *is used from the* MASS *package. Otherwise logistic regression is used. In both cases, inverse probability of treatment weights are included in the regression. If there are levels of the outcome that are not observed in this treatment group, then 0's are added in. The function returns a matrix with named columns corresponding to each outcome (ordered numerically). The entries represent the estimated covariate-conditional treatment-specific PMF.*

Description

Helper function to fit a treatment specific outcome regression. If there are more than 2 observed levels of the outcome for the specified treatment arm, then polr is used from the MASS package. Otherwise logistic regression is used. In both cases, inverse probability of treatment weights are

included in the regression. If there are levels of the outcome that are not observed in this treatment group, then 0's are added in. The function returns a matrix with named columns corresponding to each outcome (ordered numerically). The entries represent the estimated covariate-conditional treatment-specific PMF.

Usage

```
fit_trt_spec_reg(
  trt_level,
  trt_spec_prob_est,
  out,
  treat,
  covar,
  out_levels,
  out_form = NULL,
  out_model,
  stratify,
  ...
)
```

Arguments

`trt_level`	Which level of treatment to fit the proportional odds model for
`trt_spec_prob_est`	A vector of estimates of Pr(`treat` = `trt_level` | `covar`).
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`treat`	A `numeric` vector containing treatment status. Missing values are not allowed unless the corresponding entry in `out` is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).
`stratify`	Boolean indicating whether to use nonparametric maximum likelihood (i.e., a stratified estimator). If `out_form` = `"1"`, then a covariate-unadjusted estimate is computed.
`...`	Other options (not used).

getResponseFromFormula *Get a response from model formula*

Description

Get a response from model formula

Usage

```
getResponseFromFormula(formula, data)
```

Arguments

formula	The model formula
data	The data frame associated with the model

get_one_logodds *Compute one log odds based on a given data set.*

Description

Compute one log odds based on a given data set.

Usage

```
get_one_logodds(treat, covar, treat_form, out_model, out, out_levels, out_form)
```

Arguments

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
covar	A data.frame containing the covariates to include in the working proportional odds model.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.

Value

Estimated log odds for these input data.

`get_one_mannwhitney` *Compute one estimate of Mann-Whitney parameter based on a given data set.*

Description

Compute one estimate of Mann-Whitney parameter based on a given data set.

Usage

```
get_one_mannwhitney(
  treat,
  covar,
  treat_form,
  out,
  out_levels,
  out_form,
  out_model
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Missing values are not allowed unless the corresponding entry in `out` is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).

Value

Estimate of Mann-Whitney parameter for these input data.

`get_one_marg_dist` *Compute one estimate of the marginal CDF/PMF on a given data set.*

Description

Compute one estimate of the marginal CDF/PMF on a given data set.

Usage

```
get_one_marg_dist(
  treat,
  covar,
  treat_form,
  out_model,
  out,
  out_levels,
  out_form
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Should only assume a value 0 or 1.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.

Value

List of estimated cdf/pmf for these input data.

`get_one_wmean` *Compute one weighted mean based on a given data set.*

Description

Compute one weighted mean based on a given data set.

Usage

```
get_one_wmean(
  treat,
  covar,
  treat_form,
  out,
  out_levels,
  out_form,
  out_model,
  out_weights
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Missing values are not allowed unless the corresponding entry in `out` is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).
`out_weights`	A vector of `numeric` weights with length equal to the length of `out_levels`.

jack_logodds *Compute jackknife log-odds estimates.*

Description

Compute jackknife log-odds estimates.

Usage

```
jack_logodds(treat, covar, out, treat_form, out_model, out_levels, out_form)
```

Arguments

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.

Value

Jackknife estimated log-odds

jack_mannwhitney *Compute Mann-Whitney log-odds estimates.*

Description

Compute Mann-Whitney log-odds estimates.

Usage

```
jack_mannwhitney(
  treat,
  covar,
  out,
  treat_form,
  out_levels,
  out_form,
  out_model
)
```

Arguments

treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).

Value

Jackknife estimate of Mann-Whitney parameter

---

jack_marg_cdf *Compute jackknife distribution estimates.*

Description

Compute jackknife distribution estimates.

Usage

```
jack_marg_cdf(treat, covar, out, treat_form, out_levels, out_form, out_model)
```

Arguments

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).

Value

Jackknife estimated distributions

---

jack_wmean *Compute jackknife weighted mean estimates.*

Description

Compute jackknife weighted mean estimates.

Usage

```
jack_wmean(
  treat,
  covar,
  out,
  treat_form,
  out_levels,
  out_form,
  out_weights,
  out_model
)
```

Arguments

treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.

covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_weights	A vector of numeric weights with length equal to the length of out_levels.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).

Value

Jackknife-estimated weighted mean

`marginalize_cdf` *Marginalize over empirical distribution to obtain marginal treatment-specific CDF estimate.*

Description

Marginalize over empirical distribution to obtain marginal treatment-specific CDF estimate.

Usage

```
marginalize_cdf(cdf_est)
```

Arguments

cdf_est	Estimates of treatment-specific conditional CDF.

`marginalize_pmf` *Marginalize over empirical distribution to obtain marginal treatment-specific PMF estimate.*

Description

Marginalize over empirical distribution to obtain marginal treatment-specific PMF estimate.

Usage

```
marginalize_pmf(pmf_est)
```

Arguments

pmf_est	Estimates of treatment-specific conditional PMF.

---

one_boot_logodds *Get one bootstrap computation of the log odds parameters.*

Description

Get one bootstrap computation of the log odds parameters.

Usage

```
one_boot_logodds(
  treat,
  covar,
  out,
  treat_form,
  out_levels,
  out_form,
  out_model
)
```

Arguments

treat	A numeric vector containing treatment status. Should only assume a value 0 or 1.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).

Value

Estimates of log odds for a particular bootstrap sample.

`one_boot_mannwhitney` *Get one bootstrap computation of the Mann-Whitney parameter.*

Description

Get one bootstrap computation of the Mann-Whitney parameter.

Usage

```
one_boot_mannwhitney(
  treat,
  covar,
  out,
  treat_form,
  out_levels,
  out_form,
  out_model
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Missing values are not allowed unless the corresponding entry in `out` is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).

Value

Estimates of Mann-Whitney parameter for a particular bootstrap sample.

`one_boot_marg_dist` *Get one bootstrap computation of the CDF and PMF estimates*

Description

Get one bootstrap computation of the CDF and PMF estimates

Usage

```
one_boot_marg_dist(
  treat,
  covar,
  out,
  treat_form,
  out_levels,
  out_form,
  out_model
)
```

Arguments

`treat`	A `numeric` vector containing treatment status. Should only assume a value 0 or 1.
`covar`	A `data.frame` containing the covariates to include in the working proportional odds model.
`out`	A `numeric` vector containing the outcomes. Missing outcomes are allowed.
`treat_form`	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
`out_levels`	A `numeric` vector containing all ordered levels of the outcome.
`out_form`	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
`out_model`	Which R function should be used to fit the proportional odds model. Options are `"polr"` (from the `MASS` package), "vglm" (from the `VGAM` package), or `"clm"` (from the `ordinal` package).

Value

Estimates of CDF and PMF for a particular bootstrap sample.

one_boot_wmean *Get one bootstrap computation of the weighted mean parameters.*

Description

Get one bootstrap computation of the weighted mean parameters.

Usage

```
one_boot_wmean(
  treat,
  covar,
  out,
  treat_form,
  out_levels,
  out_form,
  out_weights,
  out_model
)
```

Arguments

treat	A numeric vector containing treatment status. Missing values are not allowed unless the corresponding entry in out is also missing. Only values of 0 or 1 are treated as actual treatment levels. Any other value is assumed to encode a value for which the outcome is missing and the corresponding outcome value is ignored.
covar	A data.frame containing the covariates to include in the working proportional odds model.
out	A numeric vector containing the outcomes. Missing outcomes are allowed.
treat_form	The right-hand side of a regression formula for the working model of treatment probability as a function of covariates
out_levels	A numeric vector containing all ordered levels of the outcome.
out_form	The right-hand side of a regression formula for the working proportional odds model. NOTE: THIS FORMULA MUST NOT SUPPRESS THE INTERCEPT.
out_weights	A vector of numeric weights with length equal to the length of out_levels.
out_model	Which R function should be used to fit the proportional odds model. Options are "polr" (from the MASS package), "vglm" (from the VGAM package), or "clm" (from the ordinal package).

Value

Estimates of weighted mean for a particular bootstrap sample.

plot.drord *Print the output of a "drord" object.*

Description

Print the output of a "drord" object.

Usage

```
## S3 method for class 'drord'
plot(
  x,
  treat_labels = c(1, 0),
  dist = "pmf",
  out_labels = if (dist == "pmf") {     x$out_levels } else {
    x$out_levels[-length(x$out_levels)] },
  ...
)
```

Arguments

x	A "drord" object.
treat_labels	Labels for the treatment variables (treat = 1 followed by treat = 0).
dist	Which distribution to plot. Valid options are "cdf" or "pmf".
out_labels	Labels for the ordered outcome levels. If dist = "cdf", the highest level of outcome will be dropped.
...	Other arguments (not used)

Value

A list with named entries plot (a ggplot2 object) and plot_data, the data.frame from which the plot is made. The latter is included for additional modifications to the plot that are desired.

POplugin *Fits a proportional odds model via pooled logistic regression.*

Description

The outcome in data (indicated in the form object) should be an ordered factor.

Usage

```
POplugin(form, data, weights = 1)
```

Arguments

form	The model formula
data	The data set used to fit the model
weights	Either equal to 1 (no weights) or a vector of length equal to nrow(data)

Value

A list with the fitted glm, the original data, levels of the outcome, and the outcome name

---

predict.POplugin *Predict method for a* POplugin *object*

Description

Predict method for a POplugin object

Usage

```
## S3 method for class 'POplugin'
predict(object, newdata = NULL)
```

Arguments

object	An object of class POplugin
newdata	A data.frame on which to predict

Value

A data frame with nrow = number of rows in newdata (or the orignal data frame) and with the number of columns equal to the number of levels of the outcome observed in the original data frame

---

print.drord *Print the output of a* "drord" *object.*

Description

Print the output of a "drord" object.

Usage

```
## S3 method for class 'drord'
print(x, ci = "bca", ...)
```

Arguments

x	A "drord" object
ci	Which confidence interval should be printed. Defaults to BCa, but it BCa was not computed in call to drord, defaults back to Wald.
...	Other arguments (not used)

---

trimmed_logit *Trimmed logistic function*

Description

Trimmed logistic function

Usage

```
trimmed_logit(x)
```

Arguments

x	A numeric between 0 and 1

---

wald_ci_wmean *Compute a Wald confidence interval for the weighted mean*

Description

Compute a Wald confidence interval for the weighted mean

Usage

```
wald_ci_wmean(wmean_est, alpha)
```

Arguments

wmean_est	The estimated weighted means + estimated covariance matrix.
alpha	Level of confidence interval.

Value

matrix with treatment-specific weighted mean CIs and CI for difference.

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