Package 'winPSW'

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Title Propensity Score Weighting for Win Statistics with Ordinal Outcomes in Randomized Clinical Trials

Version 0.1

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Description Supports propensity score weighting analysis of covariate-adjusted win statistics with ordinal outcomes in randomized clinical trials. This package provides five estimators including unadjusted (without covariate adjustment), IPW (inverse probability treatment weight), OW (overlap weight), AIPW (augmented IPW) and AOW (augmented OW) for calculating the point and interval estimates of the win probability (WP), loss probability (LP), win ratio (WR), and win difference (WD) in randomized trials with ordinal outcomes. We perform the methods considered in Cao et al.(2025) Covariate-adjusted win statistics in randomized clinical trials.

License GPL

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Imports stats,MASS

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NeedsCompilation no

R topics documented:

`winpsw_data` *Generate data with ordinal outcomes and corresponding covariates in a randomized clinical trial*

Description

This function can generate ordinal outcomes with three levels and 6 covariates with quadratic terms of continuous covariates in a randomized clinical trial

Usage

```
winpsw_data(n, betatrt, betactrl, b01, b02, sds, bernparam, pe)
```

Arguments

`n`	sample size of the data set
`betatrt`	a vector of regression coefficients of linear predictors for ordinal outcome model in treatment group
`betactrl`	a vector of regression coefficients of linear predictors for ordinal outcomes model in control group
`b01`	intercept for ordinal outcome model in treatment group
`b02`	intercept for ordinal outcome model in control group
`sds`	a vector of standard errors for three continuous covariates
`bernparam`	a vector of probabilities for generating three binary covariates
`pe`	the probability for generating treatment variable in a randomized clinical trial

Value

A data.frame including ordinal outcome, treatment, covariates x1-x6, and quadratic terms of 3 continuous covariates

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Examples

```
set.seed(123456)
n = 200
betatrt = c(1,-1,1,-1,1,-1)
betactrl = c(0.5,-0.5,0.5,-0.5,0.5,-0.5)
b01 = 1
b02 = 0.05
sds = c(0.3,0.4,0.5)
bernparam = c(0.75,0.50,0.25)
pe = 0.5
mydata = winpsw_data(n,betatrt,betactrl,b01,b02,sds,bernparam,pe)
print(mydata)
```

`winstat_aipw` *Estimate win statistics by AIPW method*

Description

The AIPW (i.e., augmented inverse probability weight) method is a Hajek-type estimator by leveraging U-statistic theory, see section 4 of paper (Cao et al., 2025). The point estimate is based on formula (19) of paper with IPW weights, and variance estimate is based on formula (20) of paper with IPW weights. In addition to estimating point estimates of four win statistics, that is, win probability (WP), loss probability (LP), win ratio (WR) and win difference (WD), their standard errors as well as 95% confidence intervals will also be returned

Usage

```
winstat_aipw(data, outcomevar, treatment, covariate, covariate_reg)
```

Arguments

`data`	A dataset of randomized controlled trials (RCT), which should include ordinal outcome, treatment and covariates
`outcomevar`	the name of the outcome in RCT data
`treatment`	the name of the treatment in RCT data
`covariate`	the name of vector covariates used in the propensity score model
`covariate_reg`	the name of vector covariates used in the outcome model (i.e., ordinal logistic regression model)

Value

A data.frame containing point and interval estimates of WP, LP, WR and WD

Author(s)

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References

Cao Z., Zuo S., Ryan M.M., Davis-Plourde K., Heagerty P., Tong G. and Li F. Covariate-adjusted win statistics in randomized clinical trials. under review. 2025;0(0):1-20.

Examples

```
set.seed(123456)
n = 200
betatrt = c(1,-1,1,-1,1,-1)
betactrl = c(0.5,-0.5,0.5,-0.5,0.5,-0.5)
b01 = 1
b02 = 0.05
sds = c(0.3,0.4,0.5)
bernparam = c(0.75,0.50,0.25)
pe = 0.5
```

```
mydata = winpsw_data(n,betatrt,betactrl,b01,b02,sds,bernparam,pe)

# example 1
res1 = winstat_aipw(data=mydata, outcomevar="outcome", treatment="treatment",
       covariate=paste0("x",1:6,seq=""),
       covariate_reg=c(paste0("x",1:6,seq=""),paste0("x",1:3,"s",seq="")))
print(res1)
```

`winstat_aow` *Estimate win statistics by AOW method*

Description

The AOW (i.e., augmented overlap weight) method is a Hajek-type estimator by leveraging U-statistic theory, see section 4 of paper (Cao et al., 2025). The point estimate is based on formula (19) of paper with OW weights, and variance estimate is based on formula (20) of paper with OW weights. In addition to estimating point estimates of four win statistics, that is, win probability (WP), loss probability (LP), win ratio (WR) and win difference (WD), their standard errors as well as 95% confidence intervals will also be returned

Usage

```
winstat_aow(data, outcomevar, treatment, covariate, covariate_reg)
```

Arguments

`data`	A dataset of randomized controlled trials (RCT), which should include ordinal outcome, treatment and covariates
`outcomevar`	the name of the outcome in RCT data
`treatment`	the name of the treatment in RCT data
`covariate`	the name of vector covariates used in the propensity score model
`covariate_reg`	the name of vector covariates used in the outcome model (i.e., ordinal logistic regression model)

Value

A data.frame containing point and interval estimates of WP, LP, WR and WD

Author(s)

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Examples

```
set.seed(123456)
n = 200
betatrt = c(1,-1,1,-1,1,-1)
betactrl = c(0.5,-0.5,0.5,-0.5,0.5,-0.5)
b01 = 1
b02 = 0.05
sds = c(0.3,0.4,0.5)
bernparam = c(0.75,0.50,0.25)
pe = 0.5
mydata = winpsw_data(n,betatrt,betactrl,b01,b02,sds,bernparam,pe)

# example 1
res1 = winstat_aow(data=mydata, outcomevar="outcome", treatment="treatment",
       covariate=paste0("x",1:6,seq=""),
       covariate_reg=c(paste0("x",1:6,seq=""),paste0("x",1:3,"s",seq="")))
print(res1)
```

`winstat_ipw` *Estimate win statistics by IPW method*

Description

The IPW (i.e., the inverse probability weight) method is a Hajek-type estimator by leveraging U-statistic theory, see section 3 of paper (Cao et al., 2025). The point estimate is based on formula (9) of paper with IPW weights, and variance estimate is based on formula (15) of paper with IPW weights. In addition to estimating point estimates of four win statistics, that is, win probability (WP), loss probability (LP), win ratio (WR) and win difference (WD), their standard errors as well as 95% confidence intervals will also be returned

Usage

```
winstat_ipw(data, outcomevar, treatment, covariate)
```

Arguments

`data`	A dataset of randomized controlled trials (RCT), which should include ordinal outcome, treatment and covariates
`outcomevar`	the name of the outcome in RCT data
`treatment`	the name of the treatment in RCT data
`covariate`	the name of vector covariates used in the propensity score model

Value

A data.frame containing point and interval estimates of WP, LP, WR and WD

Author(s)

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References

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Examples

```
set.seed(123456)
n = 200
betatrt = c(1,-1,1,-1,1,-1)
betactrl = c(0.5,-0.5,0.5,-0.5,0.5,-0.5)
b01 = 1
b02 = 0.05
sds = c(0.3,0.4,0.5)
bernparam = c(0.75,0.50,0.25)
pe = 0.5
mydata = winpsw_data(n,betatrt,betactrl,b01,b02,sds,bernparam,pe)

# example 1
res1 = winstat_ipw(data=mydata, outcomevar="outcome", treatment="treatment",
       covariate=paste0("x",1:6,seq=""))
print(res1)
```

`winstat_ow` *Estimate win statistics by OW method*

Description

The OW (i.e., overlap weight) method is a Hajek-type estimator by leveraging U-statistic theory, see section 3 of paper (Cao et al., 2025). The point estimate is based on formula (9) of paper with OW weights, and variance estimate is based on formula (15) of paper with OW weights. In addition to estimating point estimates of four win statistics, that is, win probability (WP), loss probability (LP), win ratio (WR) and win difference (WD), their standard errors as well as 95% confidence intervals will also be returned

Usage

```
winstat_ow(data, outcomevar, treatment, covariate)
```

Arguments

`data`	A dataset of randomized controlled trials (RCT), which should include ordinal outcome, treatment and covariates
`outcomevar`	the name of the outcome in RCT data
`treatment`	the name of the treatment in RCT data
`covariate`	the name of vector covariates used in the propensity score model

Value

A data.frame containing point and interval estimates of WP, LP, WR and WD

Author(s)

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Examples

```
set.seed(123456)
n = 200
betatrt = c(1,-1,1,-1,1,-1)
betactrl = c(0.5,-0.5,0.5,-0.5,0.5,-0.5)
b01 = 1
b02 = 0.05
sds = c(0.3,0.4,0.5)
bernparam = c(0.75,0.50,0.25)
pe = 0.5
mydata = winpsw_data(n,betatrt,betactrl,b01,b02,sds,bernparam,pe)

# example 1
res1 = winstat_ow(data=mydata, outcomevar="outcome", treatment="treatment",
       covariate=paste0("x",1:6,seq=""))
print(res1)
```

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winstat_unadj *Estimate win statistics by unadjusted method*

Description

The unadjusted estimator (i.e., without covariate adjustment) is realized by two methods introduced in paper (Cao et al., 2025). When using the Bebu and Lachin method (BLM), the point estimate is based on formula (4) of paper, and variance estimate is based on formula (5) of paper. When using the influence function method (IFM), the point estimate is based on formula (9) of paper with weights =1, and variance estimate is based on formula (18) of paper. In addition to estimating point estimates of four win statistics, that is, win probability (WP), loss probability (LP), win ratio (WR) and win difference (WD), their standard errors as well as 95% confidence intervals will also be returned

Usage

```
winstat_unadj(data, outcomevar, treatment, method = "IFM")
```

Arguments

data	A dataset of randomized controlled trials (RCT), which should include ordinal outcome and treatment.
outcomevar	the name of the outcome in RCT data
treatment	the name of the treatment in RCT data

method	the method used to estimate variance of WP and LP. Two methods are provided, one is the default influence function method (IFM), the other is the Bebu and Lachin method (BLM)

Value

A data.frame containing point and interval estimates of WP, LP, WR and WD

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References

Cao Z., Zuo S., Ryan M.M., Davis-Plourde K., Heagerty P., Tong G. and Li F. Covariate-adjusted win statistics in randomized clinical trials. under review. 2025;0(0):1-20.

Bebu I. and Lachin J. Large sample inference for a win ratio analysis of a composite outcome based on prioritized components. Biostatistics 2016; 17(1): 178-187.

Examples

```
set.seed(123456)
n = 200
betatrt = c(1,-1,1,-1,1,-1)
betactrl = c(0.5,-0.5,0.5,-0.5,0.5,-0.5)
b01 = 1
b02 = 0.05
sds = c(0.3,0.4,0.5)
bernparam = c(0.75,0.50,0.25)
pe = 0.5
mydata = winpsw_data(n,betatrt,betactrl,b01,b02,sds,bernparam,pe)
# example 1: using the default IFM method
res1 = winstat_unadj(data=mydata, outcomevar="outcome", treatment="treatment")
print(res1)
# example 2: Bebu and Lachin method
res2 = winstat_unadj(data=mydata, outcomevar="outcome", treatment="treatment",method="BLM")
print(res2)
```

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