Package 'tLagPropOdds'

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Type Package

Title Proportional Odds Model with Censored, Time-Lagged Categorical Outcome

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Description Implements a semiparametric estimator for the odds ratio model with censored, time-lagged, ordered categorical outcome in a randomized clinical trial that incorporates baseline and time-dependent information. Tsiatis, A. A. and Davidian, M. (2021) <arXiv:2106.15559>.

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Depends methods

Imports survival, stats, dplyr, R.utils

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Collate 'infl.R' 'augment.R' 'aipw.R' 'prob_aipw.R' 'kaplanMeier.R' 'prob_ipw.R' 'verifyInputs.R' 'catProbs.R' 'ipw.R' 'print.catProbsObj.R' 'print.tLagPropOdds.R' 'tLagData.R' 'tLagPropOdds.R'

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R topics documented:

`catProbs` *Estimation of the Probability of a Specific Categorical Outcome by Treatment*

Description

Inverse probability weighted complete case (IPWCC) and augmented inverse probability weighted complete case (AIPWCC) estimators for the probability of falling into a specific time-lagged ordered categorical outcome in a randomized clinical trial.

Usage

```
catProbs(data, ..., ti = NULL, td = NULL)
```

Arguments

`data`	A data.frame object. A data.frame containing all observed data. At a minimum, this data.frame must contain columns with headers "id", "U", "delta", "Cat" and "A". If the time-independent component of the estimator is to be included, data.frame must also contain the bases of f(X). If the time-dependent component is included, data.frame must also contain the bases of h(X,L) as well as the time intervals with column headers {"tstart", "tstop"} or {"start","stop"}. See Details for additional information.
`...`	Ignored. Included to require named inputs.
`ti`	A character or integer vector or NULL. The columns of data to be included in the time-independent component of the estimator, f_m(X) m = 0, ..., M. If NULL, the time-independent component is excluded from the AIPWCC estimator. See Details for additional information.
`td`	A character or integer vector or NULL. The columns of data to be included in the time-dependent component of the estimator, h_l(X,Lbar), l = 1, ..., L. If NULL, the time-dependent component is excluded from the AIPWCC estimator. See Details for additional information.

Details

At a minimum, the data provided for the analysis must contain the following information:

id: A unique participant identifier.

U: The time to ascertainment of category or censoring.

delta: The indicator of ascertainment of category (1 if U is the time to ascertainment; 0 otherwise).

Cat: The ordered outcome category. Data must be provided as a factor or an integer or be able to be converted to an integer without loss of information. If participant was censored (delta = 0), Cat can take any integer-like value or NA.

A: The treatment received. Data must be provided as a factor or an integer or be able to be converted to an integer without loss of information.

With the exception of Cat, data must be complete.

If the time-independent component is to be included in the AIPWCC estimator, data must also include the time-independent basis functions f_m(X) m = 0, ..., M. If the intercept (f_0) term is not provided, it will be added by the software.

If the time-dependent component is to be included in the AIPWCC estimator, the data.frame must be a time-dependent dataset as described by package survival. Specifically, the time-dependent data must be specified for intervals (start,stop], and the data must include the following additional columns:

tstart: The lower boundary of the time interval to which the data pertain.

tstop: The upper boundary of the time interval to which the data pertain.

Note that column headers {"start", "stop"} are also accepted.

The various combinations of inputs ti and td yield the following:

ti = NULL, td = NULL the IPWCC estimate is returned. (denoted as IPW in the simulations of the original manuscript.)

ti != NULL, td != NULL the IPWCC and the full AIPWCC estimates are returned. (denoted as AIPW2 in the simulations of the original manuscript.)

ti = NULL, td != NULL the IPWCC and the partial, time-independent AIPWCC estimates are returned. (denoted as AIPW1 in the simulations of the original manuscript.)

ti = NULL, td != NULL the IPWCC and the partial, time-dependent AIPWCC estimates are returned.

If a treatment subgroup has <5% censoring, a message is generated and the treatment subgroup is removed from the time-dependent component of the AIPWCC estimator. If there is no censoring, the IPWCC estimator approaches the usual proportional odds estimator.

Value

An S3 object of class catProbsObj containing a list. The elements of the list correspond to the selected AIPWCC and/or IPWCC estimators. For each estimator, a list of matrix objects is returned, one for each treatment, that contains the estimated probabilities, their asymptotic standard errors, and the 95% confidence intervals. The S3 object has an additional attributes, "type", giving a verbose description of the components contained in the estimator.

Examples

```
data(tLagData)

# full AIPWCC estimator
catProbs(data = tLagData, ti = "x", td = c("hospStatus", "daysOut"))

# partial, time-independent AIPWCC estimator
catProbs(data = tLagData, ti = "x")

# partial, time-dependent AIPWCC estimator
catProbs(data = tLagData, td = c("hospStatus", "daysOut"))
```

print *Print Analysis Results*

Description

Prints the key results.

Prints the key results.

Usage

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

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

Arguments

x	A tLagObj object. The value returned by tLagPropOdds().
...	Ignored.

Examples

```
data(tLagData)

# full AIPWCC estimator
res <- catProbs(data = tLagData,
                ti = "x",
                td = c("hospStatus", "daysOut"))

print(x = res)

data(tLagData)

# full AIPWCC estimator
res <- tLagPropOdds(data = tLagData,
                    ti = "x",
                    td = c("hospStatus", "daysOut"))

print(x = res)
```

tLagData *Toy Dataset For Illustration*

Description

These data are provided for the purposes of illustrating the use of the software. Though the data were generated under a scenario similar to a real-world COVID-19 therapeutics clinical trial, they should not be interpreted as representing true clinical trial data.

Usage

```
data(tLagData)
```

Format

tLagData is a time-dependent data.frame containing the following information for 602 participants ascertained at day 90 of a fictitious randomized clinical trial.

id: A unique participant identifier.

A: The treatment received, where A={0,1}.

Cat: The ordered outcome category. There are 6 categories ascertained at day 90.

- **1:** at home and off oxygen, number of days >= 77;
- **2:** at home and off oxygen, number of days 49-76;
- **3:** at home and off oxygen, number of days 1-48;
- **4:** not hospitalized and either at home on oxygen or not home;
- **5:** hospitalized for medical care or in hospice care; and
- **6:** dead.

If participant is censored, Cat = NA.

U: The time at which the outcome category was determined or the censoring time. For Cat = 1-5, U is the interim analysis time (90 days). For Cat = 6, U is the time of death. For Cat = NA, U is the censoring time.

delta: The event indicator (1 if U is the time at which the outcome category was determined; 0 if censored).

x: A continuous baseline covariate.

start: The lower bound of the time interval to which the given covariate values pertain.

stop: The upper bound of the time interval to which the given covariate values pertain.

hospStatus: A time-dependent indicator of hospital status, where 1 indicates that the participant was not in the hospital during interval (start, stop]; 0 otherwise.

daysOut: The expected number of continuous days out of hospital at the time of the interim analysis (90 days).

`tLagPropOdds` *Estimation of the Odds Ratio in a Proportional Odds Model with Censored Time-lagged Outcome*

Description

Inverse probability weighted complete case (IPWCC) and augmented inverse probability weighted complete case (AIPWCC) estimators for the odds ratio in a proportional odds model with time-lagged ordered categorical outcome in a randomized clinical trial.

Usage

```
tLagPropOdds(data, ..., ti = NULL, td = NULL, itmax = 500, tol = 1e-05)
```

Arguments

`data`	A data.frame object. A data.frame containing all observed data. At a minimum, this data.frame must contain columns with headers "id", "U", "delta", "Cat" and "A". If the time-independent component of the estimator is to be included, data.frame must also contain the bases of f(X). If the time-dependent component is included, data.frame must also contain the bases of h(X,L) as well as the time intervals with column headers {"tstart", "tstop"} or {"start","stop"}. See Details for additional information.
`...`	Ignored. Included to require named inputs.
`ti`	A character or integer vector or NULL. The columns of data to be included in the time-independent component of the estimator, f_m(X) m = 0, ..., M. If NULL, the time-independent component is excluded from the AIPWCC estimator. See Details for additional information.
`td`	A character or integer vector or NULL. The columns of data to be included in the time-dependent component of the estimator, h_l(X,Lbar), l = 1, ..., L. If NULL, the time-dependent component is excluded from the AIPWCC estimator. See Details for additional information.
`itmax`	An integer object. The maximum number of iterations for the Newton-Raphson algorithm used to estimate parameters alpha and beta.
`tol`	A numeric object. The value at which the Newton-Raphson is deemed to have converged.

Details

At a minimum, the data provided for the analysis must contain the following information:

id: A unique participant identifier.

U: The time to ascertainment of category or censoring.

delta: The indicator of ascertainment of category (1 if U is the time to ascertainment; 0 otherwise).

Cat: The ordered outcome category. Data must be provided as a factor or an integer or be able to be converted to an integer without loss of information. If participant was censored (delta = 0), Cat can take any integer-like value or NA.

A: The treatment received. Data must be provided as a factor or an integer or be able to be converted to an integer without loss of information.

With the exception of Cat, data must be complete.

If the time-independent component is to be included in the AIPWCC estimator, data must also include the time-independent basis functions f_m(X) m = 0, ..., M. If the intercept (f_0) term is not provided, it will be added by the software.

If the time-dependent component is to be included in the AIPWCC estimator, the data.frame must be a time-dependent dataset as described by package survival. Specifically, the time-dependent data must be specified for intervals (start,stop], and the data must include the following additional columns:

tstart: The lower boundary of the time interval to which the data pertain.

tstop: The upper boundary of the time interval to which the data pertain.

Note that column headers {"start", "stop"} are also accepted.

The various combinations of inputs ti and td yield the following:

ti = NULL, td = NULL the IPWCC estimate is returned. (denoted as IPW in the simulations of the original manuscript.)

ti != NULL, td != NULL the IPWCC and the full AIPWCC estimates are returned. (denoted as AIPW2 in the simulations of the original manuscript.)

ti = NULL, td != NULL the IPWCC and the partial, time-independent AIPWCC estimates are returned. (denoted as AIPW1 in the simulations of the original manuscript.)

ti = NULL, td != NULL the IPWCC and the partial, time-dependent AIPWCC estimates are returned. (not discussed in the simulations of the original manuscript.)

If a treatment subgroup has <5% censoring, a message is generated and the treatment subgroup is removed from the time-dependent component of the AIPWCC estimator. If there is no censoring, the IPWCC estimator approaches the usual proportional odds estimator.

Value

An S3 object of class tLagObj containing a list. The elements of the list correspond to the selected AIPWCC and/or IPWCC estimators. For each estimator, two matrix objects are returned: $logOdds contains the estimated beta parameters, their standard errors estimated using the sandwich estimator, the 95% confidence intervals, and the p-values for the log odds ratio; $odds contains the estimated odds ratio, their standard errors estimated using the delta method, and the 95% confidence intervals. The S3 object has an additional attribute, "type" giving a verbose description of the components contained in the estimator.

Examples

```
data(tLagData)

# full AIPWCC estimator
tLagPropOdds(data = tLagData, ti = "x", td = c("hospStatus", "daysOut"))

# partial, time-dependent AIPWCC estimator
tLagPropOdds(data = tLagData, td = c("hospStatus", "daysOut"))

# partial, time-independent AIPWCC estimator
tLagPropOdds(data = tLagData, ti = "x")
```

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