Package ‘ivitr’

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Type Package
Title Estimate IV-Optimal Individualized Treatment Rules
Version 0.1.0
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Description A method that estimates an IV-optimal individualized treatment rule. An individualized treatment rule is said to be IV-optimal if it minimizes the maximum risk with respect to the putative IV and the set of IV identification assumptions. Please refer to <arXiv:2002.02579> for more details on the methodology and some theory underpinning the method. Function IV-PILE() uses functions in the package 'locClass'. Package 'locClass' can be accessed and installed from the 'R-Forge' repository via the following link: <https://r-forge.r-project.org/projects/locclass/>. Alternatively, one can install the package by entering the following in R: `install.packages('locClass', repos='<http://R-Forge.R-project.org>')`.

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Suggests locClass
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Repository CRAN
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R topics documented:

   dt_Rouse .......................................................... 2
Description

Variables of the dataset is as follows:

- **educ86**: Years of education since 1986.
- **twoyr**: Attending a two-year college immediately after high school.
- **female**: Gender: 1 if female and 0 otherwise.
- **black**: Race: 1 if African American and 0 otherwise.
- **hispanic**: Race: 1 if Hispanic and 0 otherwise.
- **bytest**: Test score.
- **dadsome**: Dad’s education: some college.
- **dadcoll**: Dad’s education: college.
- **momsome**: Mom’s education: some college.
- **momcoll**: Mom’s education: college.
- **fincome**: Family income.
- **fincmiss**: Missingness indicator for family income.
- **tuition2**: Average state two-year college tuition.
- **tuition4**: Average state four-year college tuition.
- **dist2yr**: Distance to the nearest two-year college.
- **dist4yr**: Distance to the nearest four-year college.

Usage

```r
data(dt_Rouse)
```

Format

A data frame with 4437 rows and 16 columns.

Source

ss
Description

`estimate_BP_bound` estimates the Balke-Pearl bound for each instance in the input dataset with a binary IV, observed covariates, a binary treatment indicator, and a binary outcome.

Usage

```r
estimate_BP_bound(dt, method = "rf", nodesize = 5)
```

Arguments

- `dt`: A dataframe whose first column is a binary IV 'Z', followed by q columns of observed covariates, followed by a binary treatment indicator 'A', and finally followed by a binary outcome 'Y'. The dataset has q+3 columns in total.
- `method`: A character string indicator the method used to estimate each constituent conditional probability of the Balke-Pearl bound. Users can choose to fit multinomial regression by setting method = 'multinom', and random forest by setting method = 'rf'.
- `nodesize`: Node size to be used in a random forest algorithm if method is set to 'rf'. The default value is set to 5.

Value

The original dataframe with two additional columns: L and U. L indicates the Balke-Pearl lower bound and U is the Balke-Pearl upper bound.

Examples

```r
attach(dt_Rouse)
# Construct an IV out of differential distance to two-year versus
# four-year college. Z = 1 if the subject lives not farther from
# a 4-year college compared to a 2-year college.
Z = (dist4yr <= dist2yr) + 0

# Treatment A = 1 if the subject attends a 4-year college and 0
# otherwise.
A = 1 - twoyr

# Outcome Y = 1 if the subject obtained a bachelor's degree
Y = (educ86 >= 16) + 0

# Prepare the dataset
dt = data.frame(Z, female, black, hispanic, bytest, dadsome,
                dadcoll, momsome, momcoll, fincome, fincmiss, A, Y)
```
# Calculate the Balke-Pearl bound by estimating each constituent conditional probability \( p(Y = y, A = a \mid Z, X) \) with a random forest.
dt_with_BP_bound_rf = estimate_BP_bound(dt, method = 'rf', nodesize = 5)

# Calculate the Balke-Pearl bound by estimating each constituent conditional probability \( p(Y = y, A = a \mid Z, X) \) with a multinomial regression.
dt_with_BP_bound_multinom = estimate_BP_bound(dt, method = 'multinom')

**estimate_Sid_bound**

Estimate the partial identification bound as in Siddique (2013, JASA) for each instance in a dataset

**Description**

estimate_Sid_bound estimates the partial identification bound for each instance in the input dataset with a binary IV, observed covariates, a binary treatment indicator, and a binary outcome according to Siddique (2013, JASA).

**Usage**

estimate_Sid_bound(dt, method = "rf", nodesize = 5)

**Arguments**

- **dt**: A dataframe whose first column is a binary IV 'Z', followed by q columns of observed covariates, followed by a binary treatment indicator 'A', and finally followed by a binary outcome 'Y'. The dataset has q+3 columns in total.
- **method**: A character string indicator the method used to estimate each constituent conditional probability of the partial identification bound. Users can choose to fit multinomial regression by setting method = 'multinom', and random forest by setting method = 'rf'.
- **nodesize**: Node size to be used in a random forest algorithm if method is set to 'rf'. The default value is set to 5.

**Value**

The original dataframe with two additional columns: L and U. L indicates the lower bound and U the upper bound as in Siddique 2013

**Examples**

attach(dt_Rouse)
# Construct an IV out of differential distance to two-year versus four-year college. Z = 1 if the subject lives not farther from a 4-year college compared to a 2-year college.
IV_PILE

\[ Z = (\text{dist4yr} \leq \text{dist2yr}) + 0 \]

# Treatment \( A = 1 \) if the subject attends a 4-year college and 0 otherwise.
# otherwise.
\[ A = 1 - \text{twoyr} \]

# Outcome \( Y = 1 \) if the subject obtained a bachelor's degree
\[ Y = (\text{educ86} \geq 16) + 0 \]

# Prepare the dataset
dt = data.frame(Z, female, black, hispanic, bytest, dadsome, dadcoll, momsome, momcoll, fincome, fincmiss, A, Y)

# Calculate the Siddique bound by estimating each constituent
# conditional probability \( p(Y = y, A = a | Z, X) \) with a random
# forest.
dt_with_Sid_bound_rf = estimate_Sid_bound(dt, method = 'rf', nodesize = 5)

# Calculate the Siddique bound by estimating each constituent
# conditional probability \( p(Y = y, A = a | Z, X) \) with a multinomial
# regression.
dt_with_Sid_bound_multinom = estimate_Sid_bound(dt, method = 'multinom')

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**IV_PILE**

*Estimate an IV-optimal individualized treatment rule*

**Description**

IV_PILE estimates an IV-optimal individualized treatment rule given a dataset with estimated partial identification intervals for each instance.

**Usage**

IV_PILE(dt, kernel = "linear", C = 1, sig = 1/(ncol(dt) - 5))

**Arguments**

- **dt** A dataframe whose first column is a binary IV 'Z', followed by q columns of observed covariates, a binary treatment indicator 'A', a binary outcome 'Y', lower endpoint of the partial identification interval 'L', and upper endpoint of the partial identification interval 'U'. The dataset has q+5 columns in total.
- **kernel** The kernel used in the weighted SVM algorithm. The user may choose between 'linear' (linear kernel) and 'radial' (Gaussian RBF kernel).
- **C** Cost of violating the constraint. This is the parameter C in the Lagrange formulation.
- **sig** Sigma in the Gaussian RBF kernel. Default is set to 1/dimension of covariates, i.e., 1/q. This parameter is not relevant for linear kernel.
Value

An object of the type \texttt{wsvm}, inheriting from \texttt{svm}.

Examples

```r
## Not run:
# It is necessary to install the package locClass in order
# to run the following code.

attach(dt_Rouse)
# Construct an IV out of differential distance to two-year versus
# four-year college. Z = 1 if the subject lives not farther from
# a 4-year college compared to a 2-year college.
Z = (dist4yr <= dist2yr) + 0

# Treatment A = 1 if the subject attends a 4-year college and 0
# otherwise.
A = 1 - twoyr

# Outcome Y = 1 if the subject obtained a bachelor's degree
Y = (educ86 >= 16) + 0

# Prepare the dataset
dt = data.frame(Z, female, black, hispanic, bytest, dadsome,
              dadcoll, momsome, momcoll, fincome, fincmiss, A, Y)

# Estimate the Balke-Pearl bound by estimating each constituent
# conditional probability p(Y = y, A = a | Z, X) with a multinomial
# regression.
dt_with_BP_bound_multinom = estimate_BP_bound(dt, method = 'multinom')

# Estimate the IV-optimal individualized treatment rule using a
# linear kernel, under the putative IV and the Balke-Pearl bound.

iv_itr_BP_linear = IV_PILE(dt_with_BP_bound_multinom, kernel = 'linear')

## End(Not run)
```
Index

* datasets
  dt_Rouse, 2

dt_Rouse, 2

estimate_BP_bound, 3
estimate_Sid_bound, 4

IV_PILE, 5