Package ‘drcarlate’

June 12, 2023

**Type**  Package

**Title**  Improving Estimation Efficiency in CAR with Imperfect Compliance

**Version**  1.2.0

**Description**  We provide a list of functions for replicating the results of the Monte Carlo simulations and empirical application of Jiang et al. (2022). In particular, we provide corresponding functions for generating the three types of random data described in this paper, as well as all the estimation strategies. Detailed information about the data generation process and estimation strategy can be found in Jiang et al. (2022) <doi:10.48550/arXiv.2201.13004>.

**License**  MIT + file LICENSE

**Encoding**  UTF-8

**LazyData**  true

**URL**

**Imports**  pracma, MASS, stringr, splus2R, glmnet, stats, purrr

**RoxygenNote**  7.2.3

**Suggests**  knitr, rmarkdown

**VignetteBuilder**  knitr

**Depends**  R (>= 2.10)

**NeedsCompilation**  no

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**Repository**  CRAN

**Date/Publication**  2023-06-12 09:40:02 UTC
**R topics documented:**

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**Index**

ATEDGP ............................ Simulates the data for ATE estimators

**Description**

ATEDGP is the version of FuncDGP under full compliance.

**Usage**

ATEDGP(dgptype, rndflag, n, g, pi)

**Arguments**

- **dgptype** A scalar. 1, 2, 3 (Almost the same as 1-3 in the paper except that it does not have the DGP for D(1) or D(0)).
- **rndflag** A scalar. method of covariate-adaptive randomization. 1-SRS; 2-WEI; 3-BCD; 4-SBR.
- **n** Sample size.
- **g** Number of strata. The authors set g = 4 in the Jiang et al. (2022).
- **pi** A g x 1 vector. Targeted assignment probabilities across strata.
ATEJLTZ

Value

ATEDGP returns a list containing 7 nx1 vectors named Y, X, S, A, Y1, Y0 and D. These seven vectors are the same as defined in Jiang et al. (2022). Note that vector X does not contain the constant term.

References


Examples

ATEDGP(dgptype = 1, rndflag = 1, n = 200, g = 4, pi = c(0.5, 0.5, 0.5, 0.5))

ATEJLTZ runs the code for ATE estimator

Description

ATEJLTZ is the version of JLTZ under full compliance.

Usage

ATEDJLTZ(iMonte, dgptype, n, g, pi, iPert, iq = 0.05, iridge = 0.001, seed = 1)

Arguments

iMonte A scalar. Monte Carlo sizes.
dgptype A scalar. The value can be string 1, 2, or 3, respectively corresponding to the three DGP schemes in the paper (See Jiang et al. (2022) for DGP details).
n Sample size.
g Number of strata. The authors set g=4 in Jiang et al. (2022).
pi Targeted assignment probability across strata.
iPert A scalar. iPert = 0 means size. Otherwise means power: iPert is the perturbation of false null.
 iq A scalar. Size of hypothesis testing. The authors set iq = 0.05 in Jiang et al. (2022).
iridge A scalar. The penalization parameter in ridge regression.
seed A scalar. The random seed, the authors set seed = 1 in Jiang et al. (2022).

Value

A table summarizing the estimated results, mProd.
References


Examples

# size, iPert = 0
ATEJLTZ(iMonte = 10, dgptype = 1, n = 200, g = 4, 
   pi = c(0.5, 0.5, 0.5, 0.5), iPert = 0, iq = 0.05, iridge = 0.001)

# power, iPert = 1
ATEJLTZ(iMonte = 10, dgptype = 1, n = 200, g = 4, 
   pi = c(0.5, 0.5, 0.5, 0.5), iPert = 1, iq = 0.05, iridge = 0.001)

---

ATEOutput

Computes linear, nonparametric and regularized ATE estimator

Description

ATEOutput is the version of Output under full compliance.

Usage

ATEOutput(ii, tau, dgptype, rndflag, n, g, pi, iPert, iq, iridge)

Arguments

ii Monte Carlo index.

tau A scalar. The simulated true LATE effect.

dgptype A Scalar. 1, 2, 3 (See Jiang et al. (2022) for DGP details).

rndflag Method of CAR (covariate-adaptive randomizations). Its value can be 1, 2, 3 or 4. 1-SRS; 2-WEI; 3-BCD; 4-SBR. See Jiang et al. (2022) for more details about CAR.

n Sample size.

G Number of strata. The authors set g = 4 in Jiang et al. (2022).

pi Targeted assignment probability across strata.

iPert A scalar. iPert = 0 means size. Otherwise means power: iPert is the perturbation of false null.

iq Size of hypothesis testing. We set iq = 0.05.

iridge A scalar. The penalization parameter in ridge regression.
**Value**

A list containing four matrices named vtauhat, vsighat, vstat and vdeci respectively. vtauhat is a 1x4 vector: (1) L (2) NL (3) R(dgp = 1 or 2) (4) R(dgp = 3). vsighat is a 1x4 vector: unscaled standard errors for vtauhat. vstat is a 1x4 vector: test statistic. vdeci is a 1x4 logical vector: if applicable, 1 means rejecting the null. 0 means not rejecting the null.

**Examples**

```r
ATEOutput(ii = 1, tau = 0.9122762, dgptype = 1,
    rndflag = 4, n = 2000, g = 4, pi = c(0.5,0.5,0.5,0.5),
    iPert = 1, iq = 0.05, iridge = 0.001)
```

**Description**

ATETrueValue is the version of TrueValue under full compliance.

**Usage**

```r
ATETrueValue(dgptype, vIdx, n, g, pi)
```

**Arguments**

- **dgptype**: A scalar. The value can be string 1, 2, or 3, respectively corresponding to the three DGP schemes in the paper (See Jiang et al. (2022) for DGP details).
- **vIdx**: A 1xR vector. The authors set vIdx=[1 2 3 4] in Jiang et al. (2022). Every number declares the method of covariate-adaptive randomization. 1-SRS; 2-WEI; 3-BCD; 4-SBR.
- **n**: Sample size.
- **g**: Number of strata. The authors set g=4 in Jiang et al. (2022).
- **pi**: Targeted assignment probability across strata.

**Value**

A 1xR vector. Simulated true ATE effect.

**References**

Examples

```
ATETrueValue(dgptype = 1, vIdx = c(1,2,3,4), n = 100, g = 4, pi = c(0.5,0.5,0.5,0.5))
ATETrueValue(dgptype = 2, vIdx = c(1,2,3,4), n = 100, g = 4, pi = c(0.5,0.5,0.5,0.5))
ATETrueValue(dgptype = 3, vIdx = c(1,2,3,4), n = 100, g = 4, pi = c(0.5,0.5,0.5,0.5))
```

CovAdptRnd Examples

Generate treatment assignment under various CARs

Description

Generate treatment assignment under various CARs.

Usage

```
CovAdptRnd(rndflag, S, pi)
```

Arguments

- **rndflag**: Index of the assignment rule. 1 for SRS; 2 for WEI; 3 for BCD; 4 for SBR
- **S**: A nx1 vector.
- **pi**: Targeted assignment probability across strata. It should be a vector with the length of max(S). It should be noted that the treatment assignment process is independent of pi when rndflag == 2 or 3.

Value

A nx1 treatment assignment vector generated according to the specified method.

References


Examples

```
CovAdptRnd(rndflag = 1, S = matrix(sample(1:4,100,TRUE)), pi = c(0.5, 0.5, 0.5, 0.5))
CovAdptRnd(rndflag = 2, S = matrix(sample(1:4,100,TRUE)), pi = c(0.5, 0.5, 0.5, 0.5))
CovAdptRnd(rndflag = 3, S = matrix(sample(1:4,100,TRUE)), pi = c(0.5, 0.5, 0.5, 0.5))
CovAdptRnd(rndflag = 4, S = matrix(sample(1:4,100,TRUE)), pi = c(0.5, 0.5, 0.5, 0.5))
```
Data used to reproduce Table 5 results in Jiang et. al. (2022)

Description
Data used to reproduce Table 5 results in Jiang et. al. (2022).

Usage
data("data_table")

Format
A data frame with 2159 observations on the following 69 variables.

X1 a numeric vector
X2 a numeric vector
X3 a numeric vector
X4 a numeric vector
X5 a numeric vector
X6 a numeric vector
X7 a numeric vector
X8 a numeric vector
X9 a numeric vector
X10 a numeric vector
X11 a numeric vector
X12 a numeric vector
X13 a numeric vector
X14 a numeric vector
X15 a numeric vector
X16 a numeric vector
X17 a numeric vector
X18 a numeric vector
X19 a numeric vector
X20 a numeric vector
X21 a numeric vector
X22 a numeric vector
X23 a numeric vector
X24 a numeric vector
X25 a numeric vector
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<td>X62</td>
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</tr>
</tbody>
</table>
feasiblePostLassoMatTool

X63 a numeric vector
X64 a numeric vector
X65 a numeric vector
X66 a numeric vector
X67 a numeric vector
X68 a numeric vector
X69 a numeric vector

References


feasiblePostLassoMatTool

Feasible Post Lasso Mat Tool

Description

Under the condition of high dimensional data, the function first selects covariables through lasso regression, then performs logit regression or linear regression according to the caller’s requirements, and finally returns the adjusted Lasso regression coefficient vector. This function has been slightly adapted for this package.

Usage

```r
feasiblePostLassoMatTool(
  x,
  y,
  MaxIter = 30,
  UpsTol = 1e-06,
  beta0 = c(),
  clusterVar = c(),
  Dist = “normal”,
  link = “identity”,
  glmTol = 1e-08,
  initScale = 0.5
)
```

Arguments

- `x` A nxk Matrix.
- `y` A nx1 vector.
- `MaxIter` Maximum iteration. The default value is 30.
- ` UpsTol ` Upper limit of tolerance. The default value is 1e-6.
FUNCEDG

beta0 NULL.

clusterVar NULL.

Dist The default value is normal.

link Link can be identity or logit. This determines the method used for regression with the selected write variable after lasso. See Jiang et al. (2022) for more details.

glmTol Maximum tolerance in GLM. The default value is 1e-8.

initScale Initial scale, the default value is 0.5.

Value

A kx1 vector, the coefficients β.

References


Examples

set.seed(1)

# Notice that when we set dgptype = 3, FuncDGP will generate a high dimensional data for us.
DGP <- FuncDGP(dgptype = 3, rndflag = 1, n = 10000, g = 4, pi = c(0.5, 0.5, 0.5, 0.5))
X <- DGP$X
Y <- DGP$Y
A <- DGP$A
S <- DGP$S
D <- DGP$D
feasiblePostLassoMatTool(x = X[S==1 & A==0,], y = Y[S==1 & A==0,])
feasiblePostLassoMatTool(x = X[S==1 & A==0,], y = D[S==1 & A==0,], link = "logit")

FuncDGP Generate Data for LATE

Description

Generate data according to one of the three DGPs in Jiang et al. (2022).

Usage

FuncDGP(dgptype, rndflag, n, g, pi)
Arguments

dgptype A Scalar. 1, 2, 3 (See Jiang et al. (2022) for DGP details)

rndflag A Scalar. Declare the method of covariate-adaptive randomization. 1-SRS; 2-WEI; 3-BCD; 4-SBR.

n Sample size

g Number of strata. The authors set g=4 in the Jiang et al. (2022).

pi Targeted assignment probability across strata.

Value

FuncDGP returns a list containing 9 nx1 vectors named Y, X, S, A, Y1, Y0, D1, D0 and D. These nine vectors are the same as defined in Jiang et al. (2022). Note that vector X does not contain the constant term.

References


Examples

FuncDGP(dgptype = 1, rndflag = 1, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 1, rndflag = 2, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 1, rndflag = 3, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 1, rndflag = 4, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))

FuncDGP(dgptype = 2, rndflag = 1, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 2, rndflag = 2, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 2, rndflag = 3, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 2, rndflag = 4, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))

FuncDGP(dgptype = 3, rndflag = 1, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 3, rndflag = 2, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 3, rndflag = 3, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
FuncDGP(dgptype = 3, rndflag = 4, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))

Description

Helps the user reproduce the results of the data simulation section of Jiang et al. (2022).

Usage

JLTZ(iMonte, dgptype, n, g, pi, iPert, iq = 0.05, iridge = 0.001, seed = 1)
Arguments

iMonte A scalar. Monte Carlo sizes.
dgptype A scalar. The value can be string 1, 2, or 3, respectively corresponding to the three random data generation methods in the paper (See Jiang et al. (2022) for DGP details).

n Sample size.
g Number of strata. We set g=4 in Jiang et al. (2022).
pi Targeted assignment probability across strata.
iPert A scalar. iPert = 0 means size. Otherwise means power: iPert is the perturbation of false null.
iq A scalar. Size of hypothesis testing. The authors set iq = 0.05.
iridge A scalar. The penalization parameter in ridge regression.
seed A scalar. The random seed, the authors set seed = 1 in Jiang et al. (2022).

Value

A table summarizing the estimated results, mProd.

References


Examples

# size, iPert = 0
JLTZ(iMonte = 10, dgptype = 1, n = 200, g = 4,
    pi = c(0.5, 0.5, 0.5, 0.5), iPert = 0, iq = 0.05, iridge = 0.001, seed = 1)

# power, iPert = 1
JLTZ(iMonte = 10, dgptype = 1, n = 200, g = 4,
    pi = c(0.5, 0.5, 0.5, 0.5), iPert = 1, iq = 0.05, iridge = 0.001, seed = 1)

LinearLogit Linear Regression or Logit Regression

Description

LinearLogit generates estimated pseudo true values for parametric models. Different estimation strategies are adopted according to different values of modelflag. See Jiang et al. (2022) for more details about different strategies.
LinearLogit

Usage

LinearLogit(Y, D, A, X, S, s, modelflag, iridge)

Arguments

Y  The outcome vector. A nx1 vector.
D  A nx1 vector.
A  The treatment assignment. A nx1 vector.
X  Extra covariate matrix, A nxK matrix without constant.
S  The strata variable.
s  A particular stratum.
modelflag  Its value ranges from characters 1, 2, and 3, respectively declaring different estimation strategies. 1-L; 2-NL; 3-R.
iridge  A scalar. The penalization parameter in ridge regression.

Value

theta_0s, theta_1s, beta_0s, beta_1s are estimated coefficients vectors. The dimension is Kx1 if modelflag = 1; (K+1)x1 if modelflag = 2 or 3.

References


Examples

```r
# set.seed(1)
DGP <- FuncDGP(dgptype = 3, rndflag = 1, n = 10000, g = 4, pi = c(0.5, 0.5, 0.5, 0.5))
X <- DGP$X
Y <- DGP$Y
A <- DGP$A
S <- DGP$S
D <- DGP$D
LinearLogit(Y = Y, D = D, A = A, X = X, S = S, s = 1, modelflag = 1, iridge = 0.001)
LinearLogit(Y = Y, D = D, A = A, X = X, S = S, s = 2, modelflag = 2, iridge = 0.001)
LinearLogit(Y = Y, D = D, A = A, X = X, S = S, s = 3, modelflag = 3, iridge = 0.001)
LinearLogit(Y = Y, D = D, A = A, X = X, S = S, s = 4, modelflag = 3, iridge = 0.001)
```
LogisticReg

*Logistic Regression Function*

**Description**

Logistic CDF(cumulative distribution function).

**Usage**

`LogisticReg(x)`

**Arguments**

- `x` A nx1 matrix.

**Value**

- `y` A nx1 matrix. `y` equals to `exp(x)/(1+exp(x))` if `y` is not NA and 0 else.

**Examples**

```r
x <- pracma::rand(5,1)
y <- LogisticReg(x = x)
```

---

norminv

*Inverse of the normal cumulative distribution function (cdf)*

**Description**

Returns the inverse cdf for the normal distribution with mean MU and standard deviation SIGMA at P value Reference: https://rdrr.io/github/maxto/qapi/src/R/stats.R

**Usage**

`norminv(p, mu = 0, sigma = 1)`

**Arguments**

- `p` probability value in range 0-1
- `mu` mean value
- `sigma` standard deviation

**Value**

numeric
Examples

```r
xx <- c(0.003, 0.026, 0.015, -0.009, -0.014, -0.024, 0.015, 0.066, -0.014, 0.039)
norminv(0.01, mean(xx), sd(xx))
```

Output

Computes All the Estimators

Description

Output is an integrated function that computes all the estimates (including NA, TSLS, L, NL, F, NP, R) used in Jiang et al. (2022). See the paper for more details.

Usage

```r
Output(ii, tau, dgptype, rndflag, n, g, pi, iPert, iq, iridge)
```

Arguments

- `ii`: Monte Carlo index.
- `tau`: A scalar. The simulated true LATE effect.
- `dgptype`: A Scalar. 1, 2, 3 (See Jiang et al. (2022) for DGP details).
- `rndflag`: Method of CAR (covariate-adaptive randomizations). Its value can be 1, 2, 3 or 4. 1-SRS; 2-WEI; 3-BCD; 4-SBR. See Jiang et al. (2022) for more details about CAR.
- `n`: Sample size.
- `g`: Number of strata. The authors set g=4 in Jiang et al. (2022).
- `pi`: Targeted assignment probability across strata.
- `iPert`: A scalar. iPert =0 means size. Otherwise means power: iPert is the perturbation of false null.
- `iq`: Size of hypothesis testing. The authors set iq = 0.05 in Jiang et al. (2022).
- `iridge`: A scalar. The penalization parameter in ridge regression.

Value

A list containing four matrices named `vtauhat`, `vsighat`, `vstat` and `vdeci` respectively. `vtauhat` is a 1x8 vector: (1) NA (2) LP (3) LG (4) F (5) NP (6) R (when dgp = 3) (7) 2SLS (8) R (when dgp = 1 or 2). `vsighat` is a 1x8 vector: unscaled standard errors for `vtauhat`. `vstat` is a 1x8 vector: test statistic. `vdeci` is a 1x8 logical vector: if applicable, 1 means rejecting the null. 0 means not rejecting the null.

References

pihat

Description

Pihat computes the targeted treatment assignment probabilities across all strata in Jiang et al. (2022) and stacks them in an nx1 vector.

Usage

pihat(A, S, stratnum = NULL)

Arguments

A           A nx1 vector.
S           A nx1 vector.
stratnum    A nx1 vector about the unique strata numbers, the default value is NULL.

Value

A nx1 vector, each element corresponds to the targeted treatment assignment probabilities across all strata in Jiang et al. (2022).

References


Examples

DGP <- FuncDGP(dgptype = 1, rndflag = 2, n = 100, g = 4, pi = c(0.5, 0.5, 0.5, 0.5))
A <- DGP["A"]
S <- DGP["S"]
pihat(A = A, S = S)
splinebasis

*For each column of an input matrix, elements which are less than the median of that column are set to 0, leaving the rest of the elements unchanged*

---

**Description**

For each column of an input matrix, elements which are less than the median of that column are set to 0, leaving the rest of the elements unchanged.

**Usage**

`splinebasis(X)`

**Arguments**

- **X**: The extra covariates, a n x K matrix. No constant included.

**Value**

H A n x K matrix. All elements of the X that are less than the median of their corresponding columns are set to 0, leaving the rest unchanged.

**Examples**

```r
library(pracma)
X <- rand(4,4)
H <- splinebasis(X = X)
```

---

**stanE**

*Compute the Estimated Standard Error of the Input Estimator*

---

**Description**

`stanE` Computes the estimated standard error of the input estimator.

**Usage**

`stanE(muY1, muY0, muD1, muD0, A, S, Y, D, tauhat, stratnum = NULL)`
Arguments

muY1  A nx1 vector of \( \hat{\mu}^Y(A=1) \)s.
muY0  A nx1 vector of \( \hat{\mu}^Y(A=0) \)s.
muD1  A nx1 vector of \( \hat{\mu}^D(A=1) \)s.
muD0  A nx1 vector of \( \hat{\mu}^D(A=0) \)s.
A     A nx1 vector. Each of its elements is the treatment assignment of the corresponding observation.
S     A nx1 vector. Each of its elements is the stratum of corresponding observation.
Y     A nx1 vector. Each of its elements is the observed outcome of interest of corresponding observation.
D     A nx1 vector. Each of its elements is a binary random variable indicating whether the individual \( i \) received treatment (\( D_i = 1 \)) or not (\( D_i = 0 \)) in the actual study.

\( \tauhat \)  A scalar. LATE estimate.

\( \text{stratnum} \)  A scalar. Number of stratum.

Value

A scalar. The estimated standard deviation in Jiang et al. (2022).

References


Examples

DGP <- FuncDGP(dgptype = 1, rndflag = 1, n = 200, g = 4, pi = c(0.5,0.5,0.5,0.5))
muY1 <- DGP["Y1"]
muY0 <- DGP["Y0"]
muD1 <- DGP["D1"]
muD0 <- DGP["D0"]
A <- DGP["A"]
S <- DGP["S"]
Y <- DGP["Y"]
D <- DGP["D"]
\( \tauhat \) <- tau(muY1, muY0, muD1, muD0, A, S, Y, D)
stanE(muY1, muY0, muD1, muD0, A, S, Y, D, tauhat)
tau

Compute Estimated LATE

Description

Computes the estimated LATE in Jiang et al. (2022).

Usage

tau(muY1, muY0, muD1, muD0, A, S, Y, D, stratnum = NULL)

Arguments

muY1  A nx1 vector of hat{mu}^Y(A=1)s.
muY0  A nx1 vector of hat{mu}^Y(A=0)s.
muD1  A nx1 vector of hat{mu}^D(A=1)s.
muD0  A nx1 vector of hat{mu}^D(A=0)s.
A     A nx1 vector. Each of its elements is the treatment assignment of the corresponding observation.
S     A nx1 vector. Each of its elements is the stratum of corresponding observation.
Y     A nx1 vector. Each of its elements is the observed outcome of interest of corresponding observation.
D     A nx1 vector. Each of its elements is a binary random variable indicating whether the individual i received treatment (Di = 1) or not (Di = 0) in the actual study.
stratnum  A nx1 vector about the unique strata numbers, the default value is NULL.

Value

A scalar. LATE estimate.

References


Examples

DGP <- FuncDGP(dgptype = 1, rndflag = 1, n = 200, g = 4, pi = c(0.5, 0.5, 0.5, 0.5))
muY1 <- DGP["Y1"]
muY0 <- DGP["Y0"]
muD1 <- DGP["D1"]
muD0 <- DGP["D0"]
A <- DGP["A"]
S <- DGP["S"]
Y <- DGP["Y"]
D <- DGP[['D']]
tau(muY1, muY0, muD1, muD0, A, S, Y, D)

TrueValue

Description

Calculate the true LATE tau in Jiang et al. (2022).

Usage

TrueValue(dgptype, vIdx, n, g, pi)

Arguments

dgptype A scalar. The value can be string 1, 2, or 3, respectively corresponding to the three random data generation methods in the paper (See Jiang et al. (2022)for DGP details)

vIdx A 1xR vector. The authors set vIdx=[1 2 3 4]. Every number declares the method of covariate-adaptive randomization which simulates the LATE across different CAR schemes: 1-SRS; 2-WEI; 3-BCD; 4-SBR.

n Sample size.

g Number of strata. The authors set g=4 in Jiang et al. (2022).

pi Targeted assignment probability across strata.

Value

A list containing two vectors named tau and mPort. tau is a 1xR vector which Simulated true LATE effect, mPort is a 3xR vector. The 1st row of mPort: the LATE of never takers across varies CAR schemes, the 2nd row of mPort: the LATE of compilers across varies CAR schemes, the 3rd row of mPort: the LATE of always takers across varies CAR schemes.

References


Examples

TrueValue(dgptype = 1, vIdx = c(1,2,3,4), n=100, g = 4, pi = c(0.5,0.5,0.5,0.5))
TrueValue(dgptype = 2, vIdx = c(1,2,3,4), n=100, g = 4, pi = c(0.5,0.5,0.5,0.5))
TrueValue(dgptype = 3, vIdx = c(1,2,3,4), n=100, g = 4, pi = c(0.5,0.5,0.5,0.5))
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