

Package ‘localIV’

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Type Package

Title Estimation of Marginal Treatment Effects using Local Instrumental Variables

Version 0.1.0

Description In the generalized Roy model, the marginal treatment effect (MTE) can be used as a building block for constructing conventional causal parameters such as the average treatment effect (ATE) and the average treatment effect on the treated (ATT) (Heckman, Urzua, and Vytlacil 2006 <doi:10.1162/rest.88.3.389>). Given a treatment selection model and an outcome model, the function `mte()` estimates the MTE via local instrumental variables (or via a normal selection model) and also the projection of MTE onto the 2-dimensional space of the propensity score and a latent variable representing unobserved resistance to treatment (Zhou and Xie 2018 <https://scholar.harvard.edu/files/xzhou/files/zhou-xie_mte2.pdf>). The object returned by `mte()` can be used to estimate conventional parameters such as ATE and ATT (via `average()`) or marginal policy-relevant treatment effects (via `mprte()`).

Depends R (>= 3.3.0)

Imports KernSmooth (>= 2.5.0), mgcv (>= 1.8-19), sampleSelection (>= 1.2-0), stats

License GPL (>= 3)

Encoding UTF-8

LazyData true

RoxygenNote 6.1.0

URL <https://github.com/xiangzhou09/localIV>

BugReports <https://github.com/xiangzhou09/localIV>

NeedsCompilation no

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average	<i>Estimation of Average Causal Effects from Marginal Treatment Effects</i>
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Description

average is a function that estimates conventional causal parameters including average treatment effect (ATE), average treatment effect on the treated (ATT), and average treatment effect on the untreated (ATU). Note that the estimation involves substantial extrapolation when the propensity score has a limited support.

Usage

```
average(mte_fit, estimand = c("ate", "att", "atu"))
```

Arguments

mte_fit	An object of class mte returned by <code>mte</code> .
estimand	Type of estimand: "ate", "att", or "atu".

Value

Estimate of ATE, ATT, or ATU.

References

Heckman, James J., Sergio Urzua, and Edward Vytlacil. 2006. "Understanding Instrumental Variables in Models with Essential Heterogeneity." *The Review of Economics and Statistics* 88:389-432.

Examples

```
mte_fit <- mte(selection = d ~ x + z, outcome = y ~ x,
  method = "localIV", data = toydata)

ate <- average(mte_fit, estimand = "ate")
att <- average(mte_fit, estimand = "att")
c(ate, att)
```

mprte	<i>Estimation of Marginal Policy Relevant Treatment Effects (MPRTE)</i>
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Description

`mprte` is a function that estimates a class of marginal policy relevant treatment effects (MPRTE) considered in Zhou and Xie (2018). The user needs to specify a policy as a scalar function of the propensity score.

Usage

```
mprte(mte_fit, policy)
```

Arguments

<code>mte_fit</code>	An object of class <code>mte</code> returned by <code>mte</code> .
<code>policy</code>	A univariate scalar function that measures the intensity of policy intervention across individuals with different levels of the propensity score.

Value

Estimate of MPRTE.

References

Zhou, Xiang and Yu Xie. Forthcoming. "Marginal Treatment Effects from A Propensity Score Perspective." *Journal of Political Economy*.

Examples

```
mte_fit <- mte(selection = d ~ x + z, outcome = y ~ x,  
  method = "localIV", data = toydata)  
  
mprte1 <- mprte(mte_fit, policy = function(p) 1)  
mprte2 <- mprte(mte_fit, policy = function(p) p)  
mprte3 <- mprte(mte_fit, policy = function(p) I(p<0.2))  
c(mprte1, mprte2, mprte3)
```

 mte

Estimation of Marginal Treatment Effects (MTE)

Description

mte is a function that estimates MTE using either local instrumental variables (local IV) or a normal selection model (Heckman, Urzua, Vytlacil 2006). The user supplies a formula for the treatment selection model, a formula for the outcome model, and a data frame containing the variables. The function returns an object of class mte. Observations which contain NA (either in selection or outcome) are removed.

Usage

```
mte(selection, outcome, data, method = c("localIV", "normal"),
     bw = 0.25)
```

Arguments

selection	A formula representing the selection equation.
outcome	A formula representing the outcome equation where the left hand side is the observed outcome and the right hand side includes predictors of both potential outcomes.
data	An optional data frame, list, or environment containing the variables in the model.
method	How to estimate the model: either "localIV" for local instrumental variables or "normal" for a normal selection model.
bw	Bandwidth used for the local polynomial regression in the local IV approach. Default is 0.25.

Value

An object of class mte.

mte	Fitted MTE function, taking two arguments, x for a vector of observed covariates and u for the latent resistance.
mte_tilde	Fitted MTE function, taking two arguments, p for the propensity score and u for the latent resistance. See Zhou and Xie (Forthcoming) for a definition.
mtr	Fitted marginal treatment response (MTR) function, taking three arguments, x for a vector of observed covariates, u for the latent resistance, and d for treatment status (1 or 2). Available only when method = "normal". See Mogstad, Santos, and Torgovitsky (Forthcoming) for a definition.
mtr_tilde	Fitted marginal treatment response (MTR) function, taking three arguments, p for the propensity score, u for the latent resistance, and d for treatment status (1 or 2). Available only when method = "normal".

coefs	A list of fitted coefficients: gamma for the treatment selection model (a probit model), beta1 for the baseline outcome, beta2 for the treated outcome, and theta1 and theta2 for the error covariances when method = "normal".
mte_mat	An N-by-100 matrix representing estimated MTE for all units, where N is the sample size. Each row represents a unit and each column represents a value of the normalized latent resistance, which runs from 0.005 to 0.995 with a step size of 0.01.
ps	Estimated propensity scores.
ps_model	The propensity score model, an object of class <code>glm</code> if method = "localIV", or an object of class <code>selection</code> if method = "normal".
Z	The model matrix for the treatment selection equation.
D	The response vector for the treatment selection equation.
X	The model matrix for the outcome equation.
Y	The observed outcome.
call	The matched call.

References

- Heckman, James J., Sergio Urzua, and Edward Vytlacil. 2006. "Understanding Instrumental Variables in Models with Essential Heterogeneity." *The Review of Economics and Statistics* 88:389-432.
- Zhou, Xiang and Yu Xie. Forthcoming. "Marginal Treatment Effects from A Propensity Score Perspective." *Journal of Political Economy*.
- Mogstad, Santos, and Torgovitsky. Forthcoming. "Using Instrumental Variables for Inference About Policy Relevant Treatment Effects." *Econometrica*.

Examples

```
mte_fit <- mte(selection = d ~ x + z, outcome = y ~ x,
  method = "localIV", data = toydata)
summary(mte_fit$ps_model)

op <- par(mfrow = c(1, 3))

# heterogeneous treatment effects by the propensity score
with(mte_fit, curve(mte_tilde(p = x, u = 0.5), 0, 1))

# heterogeneous treatment effects by the latent resistance
with(mte_fit, curve(mte_tilde(p = 0.5, u = x), 0, 1))

# heterogeneous treatment effects among marginal entrants
with(mte_fit, curve(mte_tilde(p = x, u = x), 0, 1))

par(op)
```

toydata

A Hypothetical Dataset for Illustrative Purpose

Description

A dataset containing 4 columns: *y* for a continuous outcome, *d* for a binary treatment, *x* for a pretreatment covariate, and *z* for an excluded instrument.

Usage

```
toydata
```

Format

An object of class `data.frame` with 10000 rows and 4 columns.

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