Package 'rdmulti'

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Type Package

Title Analysis of RD Designs with Multiple Cutoffs or Scores

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Description The regression discontinuity (RD) design is a popular quasi-experimental design for causal inference and policy evaluation. The 'rdmulti' package provides tools to analyze RD designs with multiple cutoffs or scores: rdmc() estimates pooled and cutoff specific effects for multi-cutoff designs, rdmcplot() draws RD plots for multi-cutoff designs and rdms() estimates effects in cumulative cutoffs or multi-score designs. See Cattaneo, Titiunik and Vazquez-Bare (2020) <https://rdpackages.github.io/references/Cattaneo-Titiunik-VazquezBare_2020_Stata.pdf> for further methodological details.

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Contents

rdmulti-package *rdmulti: analysis of RD Designs with multiple cutoffs or scores*

Description

The regression discontinuity (RD) design is a popular quasi-experimental design for causal inference and policy evaluation. The 'rdmulti' package provides tools to analyze RD designs with multiple cutoffs or scores: rdmc() estimates pooled and cutoff-specific effects in multi-cutoff designs, rdmcplot() draws RD plots for multi-cutoff RD designs and rdms() estimates effects in cumulative cutoffs or multi-score designs. For more details, and related Stata and R packages useful for analysis of RD designs, visit https://rdpackages.github.io/.

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rdmc *Analysis of RD designs with multiple cutoffs*

Description

rdmc() analyzes RD designs with multiple cutoffs.

Usage

```
rdmc(
  Y,
  X,
  C,
  fuzzy = NULL,
  derivvec = NULL,
  pooled_opt = NULL,
  verbose = FALSE,
  pvec = NULL,
  qvec = NULL,
  hmat = NULL,
  bmat = NULL,
  rhovec = NULL,
  covs_mat = NULL,
  covs_list = NULL,
  covs_dropvec = NULL,
  kernelvec = NULL,
  weightsvec = NULL,
  bwselectvec = NULL,
  scaleparvec = NULL,
  scaleregulvec = NULL,
  masspointsvec = NULL,
  bwcheckvec = NULL,
  bwrestrictvec = NULL,
  stdvarsvec = NULL,
  vcevec = NULL,
  nnmatchvec = NULL,
  cluster = NULL,
  level = 95,
  plot = FALSE,
  conventional = FALSE
)
```

Arguments

Y	outcome variable.
X	running variable.

C	cutoff variable.
fuzzy	specifies a fuzzy design. See rdrobust() for details.
derivvec	vector of cutoff-specific order of derivatives. See rdrobust() for details.
pooled_opt	options to be passed to rdrobust() to calculate pooled estimand.
verbose	displays the output from rdrobust for estimating the pooled estimand.
pvec	vector of cutoff-specific polynomial orders. See rdrobust() for details.
qvec	vector of cutoff-specific polynomial orders for bias estimation. See rdrobust() for details.
hmat	matrix of cutoff-specific bandwidths. See rdrobust() for details.
bmat	matrix of cutoff-specific bandwidths for bias estimation. See rdrobust() for details.
rhovec	vector of cutoff-specific values of rho. See rdrobust() for details.
covs_mat	matrix of covariates. See rdrobust() for details.
covs_list	list of covariates to be used in each cutoff.
covs_dropvec	vector indicating whether collinear covariates should be dropped at each cutoff. See rdrobust() for details.
kernelvec	vector of cutoff-specific kernels. See rdrobust() for details.
weightsvec	vector of length equal to the number of cutoffs indicating the names of the variables to be used as weights in each cutoff. See rdrobust() for details.
bwselectvec	vector of cutoff-specific bandwidth selection methods. See rdrobust() for details.
scaleparvec	vector of cutoff-specific scale parameters. See rdrobust() for details.
scaleregulvec	vector of cutoff-specific scale regularization parameters. See rdrobust() for details.
masspointsvec	vector indicating how to handle repeated values at each cutoff. See rdrobust() for details.
bwcheckvec	vector indicating the value of bwcheck at each cutoff. See rdrobust() for details.
bwrestrictvec	vector indicating whether computed bandwidths are restricted to the range or runvar at each cutoff. See rdrobust() for details.
stdvarsvec	vector indicating whether variables are standardized at each cutoff. See rdrobust() for details.
vcevec	vector of cutoff-specific variance-covariance estimation methods. See rdrobust() for details.
nnmatchvec	vector of cutoff-specific nearest neighbors for variance estimation. See rdrobust() for details.
cluster	cluster ID variable. See rdrobust() for details.
level	confidence level for confidence intervals. See rdrobust() for details.
plot	plots cutoff-specific estimates and weights.
conventional	reports conventional, instead of robust-bias corrected, p-values and confidence intervals.

Value

`tau`	pooled estimate
`se.rb`	robust bias corrected standard error for pooled estimate
`pv.rb`	robust bias corrected p-value for pooled estimate
`ci.rb.l`	left limit of robust bias corrected CI for pooled estimate
`ci.rb.r`	right limit of robust bias corrected CI for pooled estimate
`hl`	bandwidth to the left of the cutoff for pooled estimate
`hr`	bandwidth to the right of the cutofffor pooled estimate
`Nhl`	sample size within bandwidth to the left of the cutoff for pooled estimate
`Nhr`	sample size within bandwidth to the right of the cutoff for pooled estimate
`B`	vector of bias-corrected estimates
`V`	vector of robust variances of the estimates
`Coefs`	vector of conventional estimates
`W`	vector of weights for each cutoff-specific estimate
`Nh`	vector of sample sizes within bandwidth
`CI`	robust bias-corrected confidence intervals
`H`	matrix of bandwidths
`Pv`	vector of robust p-values
`rdrobust.results`	results from rdrobust for pooled estimate
`cfail`	Cutoffs where rdrobust() encountered problems

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References

Cattaneo, M.D., R. Titiunik and G. Vazquez-Bare. (2020). Analysis of Regression Discontinuity Designs with Multiple Cutoffs or Multiple Scores. *Stata Journal*, forthcoming.

Examples

```
# Toy dataset
X <- runif(1000,0,100)
C <- c(rep(33,500),rep(66,500))
Y <- (1 + X + (X>=C))*(C==33)+(.5 + .5*X + .8*(X>=C))*(C==66) + rnorm(1000)
# rdmc with standard syntax
tmp <- rdmc(Y,X,C)
```

rdmcplot *RD plots with multiple cutoffs.*

Description

`rdmcplot()` RD plots with multiple cutoffs.

Usage

```
rdmcplot(
  Y,
  X,
  C,
  nbinsmat = NULL,
  binselectvec = NULL,
  scalevec = NULL,
  supportmat = NULL,
  pvec = NULL,
  hmat = NULL,
  kernelvec = NULL,
  weightsvec = NULL,
  covs_mat = NULL,
  covs_list = NULL,
  covs_evalvec = NULL,
  covs_dropvec = NULL,
  ci = NULL,
  col_bins = NULL,
  pch_bins = NULL,
  col_poly = NULL,
  lty_poly = NULL,
  col_xline = NULL,
  lty_xline = NULL,
  nobins = FALSE,
  nopoly = FALSE,
  noxline = FALSE,
  nodraw = FALSE
)
```

Arguments

`Y`	outcome variable.
`X`	running variable.
`C`	cutoff variable.
`nbinsmat`	matrix of cutoff-specific number of bins. See `rdplot()` for details.
`binselectvec`	vector of cutoff-specific bins selection method. See `rdplot()` for details.

scalevec	vector of cutoff-specific scale factors. See rdplot() for details.
supportmat	matrix of cutoff-specific support conditions. See rdplot() for details..
pvec	vector of cutoff-specific polynomial orders. See rdplot() for details.
hmat	matrix of cutoff-specific bandwidths. See rdplot() for details.
kernelvec	vector of cutoff-specific kernels. See rdplot() for details.
weightsvec	vector of cutoff-specific weights. See rdplot() for details.
covs_mat	matrix of covariates. See rdplot() for details.
covs_list	list of of covariates to be used in each cutoff.
covs_evalvec	vector indicating the evaluation point for additional covariates. See rdrobust() for details.
covs_dropvec	vector indicating whether collinear covariates should be dropped at each cutoff. See rdrobust() for details.
ci	adds confidence intervals of the specified level to the plot. See rdrobust() for details.
col_bins	vector of colors for bins.
pch_bins	vector of characters (pch) type for bins.
col_poly	vector of colors for polynomial curves.
lty_poly	vector of lty for polynomial curves.
col_xline	vector of colors for vertical lines.
lty_xline	vector of lty for vertical lines.
nobins	omits bins plot.
nopoly	omits polynomial curve plot.
noxline	omits vertical lines indicating the cutoffs.
nodraw	omits plot.

Value

clist	list of cutoffs
cnum	number of cutoffs
X0	matrix of X values for control units
X1	matrix of X values for treated units
Yhat0	estimated polynomial for control units
Yhat1	estimated polynomial for treated units
Xmean	bin average of X values
Ymean	bin average for Y values
CI_l	lower end of confidence intervals
CI_r	upper end of confidence intervals
cfail	Cutoffs where rdrobust() encountered problems

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References

Cattaneo, M.D., R. Titiunik and G. Vazquez-Bare. (2020). Analysis of Regression Discontinuity Designs with Multiple Cutoffs or Multiple Scores. *Stata Journal*, forthcoming.

Examples

```
# Toy dataset
X <- runif(1000,0,100)
C <- c(rep(33,500),rep(66,500))
Y <- (1 + X + (X>=C))*(C==33)+(.5 + .5*X + .8*(X>=C))*(C==66) + rnorm(1000)
# rdmcplot with standard syntax
tmp <- rdmcplot(Y,X,C)
```

`rdms` *Analysis of RD designs with cumulative cutoffs or two running variables*

Description

`rdms()` analyzes RD designs with cumulative cutoffs or two running variables.

Usage

```
rdms(
  Y,
  X,
  C,
  X2 = NULL,
  zvar = NULL,
  C2 = NULL,
  rangemat = NULL,
  xnorm = NULL,
  fuzzy = NULL,
  derivvec = NULL,
  pooled_opt = NULL,
  pvec = NULL,
  qvec = NULL,
  hmat = NULL,
  bmat = NULL,
```

```
  rhovec = NULL,
  covs_mat = NULL,
  covs_list = NULL,
  covs_dropvec = NULL,
  kernelvec = NULL,
  weightsvec = NULL,
  bwselectvec = NULL,
  scaleparvec = NULL,
  scaleregulvec = NULL,
  masspointsvec = NULL,
  bwcheckvec = NULL,
  bwrestrictvec = NULL,
  stdvarsvec = NULL,
  vcevec = NULL,
  nnmatchvec = NULL,
  cluster = NULL,
  level = 95,
  plot = FALSE,
  conventional = FALSE
)
```

Arguments

Y	outcome variable.
X	running variable.
C	vector of cutoffs.
X2	if specified, second running variable.
zvar	if X2 is specified, treatment indicator.
C2	if specified, second vector of cutoffs.
rangemat	matrix of cutoff-specific ranges for the running variable.
xnorm	normalized running variable to estimate pooled effect.
fuzzy	specifies a fuzzy design. See `rdrobust()` for details.
derivvec	vector of cutoff-specific order of derivatives. See `rdrobust()` for details.
pooled_opt	options to be passed to `rdrobust()` to calculate pooled estimand.
pvec	vector of cutoff-specific polynomial orders. See `rdrobust()` for details.
qvec	vector of cutoff-specific polynomial orders for bias estimation. See `rdrobust()` for details.
hmat	matrix of cutoff-specific bandwidths. See `rdrobust()` for details.
bmat	matrix of cutoff-specific bandwidths for bias estimation. See `rdrobust()` for details.
rhovec	vector of cutoff-specific values of rho. See `rdrobust()` for details.
covs_mat	matrix of covariates. See `rdplot()` for details.
covs_list	list of of covariates to be used in each cutoff.

covs_dropvec	vector indicating whether collinear covariates should be dropped at each cutoff. See rdrobust() for details.
kernelvec	vector of cutoff-specific kernels. See rdrobust() for details.
weightsvec	vector of length equal to the number of cutoffs indicating the names of the variables to be used as weights in each cutoff. See rdrobust() for details.
bwselectvec	vector of cutoff-specific bandwidth selection methods. See rdrobust() for details.
scaleparvec	vector of cutoff-specific scale parameters. See rdrobust() for details.
scaleregulvec	vector of cutoff-specific scale regularization parameters. See rdrobust() for details.
masspointsvec	vector indicating how to handle repeated values at each cutoff. See rdrobust() for details.
bwcheckvec	vector indicating the value of bwcheck at each cutoff. See rdrobust() for details.
bwrestrictvec	vector indicating whether computed bandwidths are restricted to the range or runvar at each cutoff. See rdrobust() for details.
stdvarsvec	vector indicating whether variables are standardized at each cutoff. See rdrobust() for details.
vcevec	vector of cutoff-specific variance-covariance estimation methods. See rdrobust() for details.
nnmatchvec	vector of cutoff-specific nearest neighbors for variance estimation. See rdrobust() for details.
cluster	cluster ID variable. See rdrobust() for details.
level	confidence level for confidence intervals. See rdrobust() for details.
plot	plots cutoff-specific and pooled estimates.
conventional	reports conventional, instead of robust-bias corrected, p-values and confidence intervals.

Value

B	vector of bias-corrected coefficients
V	variance-covariance matrix of the estimators
Coefs	vector of conventional coefficients
Nh	vector of sample sizes within bandwidth at each cutoff
CI	bias corrected confidence intervals
H	bandwidth used at each cutoff
Pv	vector of robust p-values

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References

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Examples

```
# Toy dataset: cumulative cutoffs
X <- runif(1000,0,100)
C <- c(33,66)
Y <- (1+X)*(X<C[1])+(0.8+0.8*X)*(X>=C[1]&X<C[2])+(1.2+1.2*X)*(X>=C[2]) + rnorm(1000)
# rmds: basic syntax
tmp <- rdms(Y,X,C)
```

Index