

Title

rdmc - Analysis of Regression Discontinuity Designs with Multiple Cutoffs.

Syntax

rdmc depvar runvar [if] [in], cvar(string) [fuzzy(string) derivvar(string)
pooled_opt(string) verbose pvar(string) qvar(string) hvar(string)
hrightvar(string) bvar(string) brightvar(string) rhovar(string)
covsvar(string) covsdropvar(string) kernelvar(string) weightsvar(string)
bwselectvar(string) scaleparvar(string) scaleregulvar(string)
masspointsvar(string) bwcheckvar(string) bwrestrictvar(string)
stdvarsvar(string) vcevar(string) level(#) plot graph_opt(string)]

Description

rdmc provides tools to analyze regression discontinuity (RD) designs with multiple
 cutoffs. For methodological background see Keele and Titiunik (2015),
 Cattaneo, Keele, Titiunik and Vazquez-Bare (2016), and Cattaneo, Keele,
 Titiunik and Vazquez-Bare (2021). It also computes alternative estimation and
 inference procedures available in the literature.

Companion commands are: $\underline{rdmcplot}$ for multi-cutoff RD plots, and \underline{rdms} for multi-score RD estimation and inference.

A detailed introduction to this command is given in $\underline{\text{Cattaneo, Titiunik and Vazquez-Bare (2020)}}$.

Companion R functions are also available <u>here</u>.

This command employs the Stata (and R) package <u>rdrobust</u> for underlying calculations. See <u>Calonico</u>, <u>Cattaneo and Titiunik</u> (2014), <u>Calonico</u>, <u>Cattaneo and Titiunik</u> (2015), and <u>Calonico</u>, <u>Cattaneo</u>, <u>Farrell and Titiunik</u> (2017) for more details.

Related Stata and R packages useful for inference in RD designs are described in the following website:

https://rdpackages.github.io/

Options

Estimand

cvar(string) specifies the numeric variable containing the RD cutoff for indepvar for each unit in the sample.

fuzzy(string) indicates a fuzzy design. See rdrobust for details.

derivvar(string) a variable of length equal to the number of different cutoffs
 that specifies the order of the derivative for rdrobust to calculate
 cutoff-specific estimates. See rdrobust for details.

rdrobust Options

pooled_opt(string) specifies the options to be passed to rdrobust to calculate
 pooled estimates. See rdrobust for details.

verbose displays the output from rdrobust for estimating the pooled estimand.

Local Polynomial Regression

pvar(string) a variable of length equal to the number of different cutoffs that
 specifies the order of the polynomials for rdrobust to calculate
 cutoff-specific estimates. See rdrobust for details.

calculate cutoff-specific estimates. See rdrobust for details.

- hvar(string) a variable of length equal to the number of different cutoffs that
 specifies the bandwidths for rdrobust to calculate cutoff-specific estimates.
 When hrightvar is specified, hvar indicates the bandwidth to the left of the
 cutoff. When hrightvar is not specified, the same bandwidths are used at each
 side. See rdrobust for details.
- hrightvar(string) a variable of length equal to the number of different cutoffs
 that specifies the bandwidths to the right of the cutoff for rdrobust to
 calculate cutoff-specific estimates. When hrightvar is not specified, the
 bandwidths in hvar are used at each side. See rdrobust for details.
- bvar(string) a variable of length equal to the number of different cutoffs that
 specifies the bandwidths for bias estimation for rdrobust to calculate
 cutoff-specific estimates. When brightvar is specified, hvar indicates the
 bandwidth to the left of the cutoff. When brightvar is not specified, the
 same bandwidths are used at each side. See rdrobust for details.
- brightvar(string) a variable of length equal to the number of different cutoffs
 that specifies the bandwidths for bias estimation to the right of the cutoff
 for rdrobust to calculate cutoff-specific estimates. When brightvar is not
 specified, the bandwidths in bvar are used at each side. See rdrobust for
 details.
- rhovar(string) a variable of length equal to the number of different cutoffs that
 specifies the value of rho for rdrobust to calculate cutoff-specific
 estimates. See rdrobust for details.
- covsvar(string) a variable of length equal to the number of different cutoffs that
 specifies the covariates for rdrobust to calculate cutoff-specific estimates.
 See rdrobust for details.
- covsdropvar(string) a variable of length equal to the number of different cutoffs
 that specifies whether collinear covariates should be dropped. See rdrobust
 for details.
- kernelvar(string) a variable of length equal to the number of different cutoffs
 that specifies the kernels for rdrobust to calculate cutoff-specific
 estimates. See rdrobust for details.
- weightsvar(string) a variable of length equal to the number of different cutoffs
 that specifies the weights for rdrobust to calculate cutoff-specific
 estimates. See rdrobust for details.

Bandwidth Selection

- bwselectvar(string) a variable of length equal to the number of different cutoffs
 that specifies the bandwidth selection method for rdrobust to calculate
 cutoff-specific estimates. See rdrobust for details.
- scaleparvar(string) a variable of length equal to the number of different cutoffs
 that specifies the value of scalepar for rdrobust to calculate cutoff-specific
 estimates. See rdrobust for details.
- scaleregulvar(string) a variable of length equal to the number of different
 cutoffs that specifies the value of scaleregul for rdrobust to calculate
 cutoff-specific estimates. See rdrobust for details.
- masspointswar(string) a variable of length equal to the number of different
 cutoffs that specifies how to handle repeated values in the running variable.
 See rdrobust for details.
- bwcheckvar(string) a variable of length equal to the number of different cutoffs
 that specifies the value of bwcheck. See rdrobust for details.

bwrestrictvar(string) a variable of length equal to the number of different
 cutoffs that specifies whether computed bandwidths are restricted to the range
 of runvar. See rdrobust for details.

stdvarsvar(string) a variable of length equal to the number of different cutoffs
 that specifies whether depvar and runvar are standardized. See rdrobust for
 details.

```
☐ Variance-Covariance Estimation
```

vcevar(string) a variable of length equal to the number of different cutoffs that
specifies the variance-covariance matrix estimation method for rdrobust to
calculate cutoff-specific estimates. See rdrobust for details.

level(#) specifies the confidence level for confidence intervals. See rdrobust
 for details.

```
Plot
```

plot plots the pooled and cutoff-specific estimates and the weights given by the pooled estimate to each cutoff-specific estimate.

graph_opt(string) options to be passed to the graph when plot is specified.

Examples

```
Standard use of rdmc
. rdmc yvar xvar, c(cvar)

rdmc with plots of estimates and weights
. rdmc yvar xvar, c(cvar) plot

rdmc showing output from rdrobust and specifying uniform kernel
. rdmc yvar xvar, c(cvar) verbose pooled_opt(kernel(uniform))
```

Saved results

rdmc saves the following in e():

Scalars

```
weighted estimate
e(tau_weight)
e(se_weight_rb)
                    robust bias corrected s.e. for weighted estimate
e(pv_weight_rb)
                    robust bias corrected p-value for weighted estimate
e(ci_weight_1)
                    left limit of robust bias corrected confidence interval
                      for weighted estimate
                    right limit of robust bias corrected confidence interval
e(ci_weight_r)
                      for weighted estimate
                    effective sample size to the left of the cutoff used to
e(N_h_1)
                      estimate weighted estimand
e(N h r)
                    effective sample size to the right of the cutoff used to
                      estimate weighted estimand
e(tau_pool)
                    pooled estimate
e(se_rb)
                    robust bias corrected s.e. for pooled estimate
e (pv_rb)
                    robust bias corrected p-value
e(ci_rb_l)
                    left limit of robust bias corrected confidence interval
                    right limit of robust bias corrected confidence interval
e(ci_rb_r)
e(h_1)
                    bandwidth to the left of the cutoff used to estimate
                     pooled estimand
                    bandwidth to the right of the cutoff used to estimate
e(h_r)
                     pooled estimand
e(N_h_1)
                    sample size within bandwidth to the left of the cutoff
                     used to estimate pooled estimand
                    sample size within bandwidth to the right of the cutoff
e(N_h_r)
                      used to estimate pooled estimand
```

Matrices

e(b) bias-corrected coefficient vector

e(V) robust variance-covariance matrix of the estimators

e(coefs) conventional coefficient vector

e(pv_rb) robust p-value vector

e(CI_rb) bias-corrected confidence intervals

e(H) vector of bandwidths at each side of each cutoff

e(weights) vector of weights for each cutoff-specific estimate

e(sampsis) vector of sample sizes at each side of each cutoff

References

- Calonico, S., M. D. Cattaneo, M. H. Farrell, and R. Titiunik. 2017. rdrobust: software for Regression Discontinuity Designs.

 Stata Journal 17(2): 372-404.
- Calonico, S., M. D. Cattaneo, and R. Titiunik. 2014. <u>Robust Data-Driven Inference in the Regression-Discontinuity Design</u>.

 Stata Journal 14(4): 909-946.
- Calonico, S., M. D. Cattaneo, and R. Titiunik. 2015. rdrobust: An R Package for Robust Nonparametric Inference in Regression-Discontinuity Designs.

 R Journal 7(1): 38-51.
- Cattaneo, M. D., L. Keele, R. Titiunik, and G. Vazquez-Bare. 2016. <u>Interpreting Regression Discontinuity Designs with Multiple Cutoffs</u>.

 Journal of Politics 78(4): 1229-1248.
- Cattaneo, M. D., L. Keele, R. Titiunik, and G. Vazquez-Bare. 2021. <u>Extrapolating Treatment Effects in Multi-Cutoff Regression Discontinuity Designs</u>.

 Journal of American Statistical Association, forthcoming.
- Cattaneo, M. D., R. Titiunik, and G. Vazquez-Bare. 2020. <u>Analysis of Regression Discontinuity Designs with Multiple Cutoffs or Multiple Scores</u>.

 Stata Journal, forthcoming.
- Keele, L., and R. Titiunik. 2015. Geographic Boundaries as Regression
 Discontinuities.
 Political Analysis 23(1): 127-155.

<u>Authors</u>

- Matias D. Cattaneo, Princeton University, Princeton, NJ. cattaneo@princeton.edu.
- Rocio Titiunik, Princeton University, Princeton, NJ. titiunik@princeton.edu.
- Gonzalo Vazquez-Bare, UC Santa Barbara, Santa Barbara, CA. gvazquez@econ.ucsb.edu.