



## Title

**rdbwselect** — Bandwidth Selection Procedures for Local Polynomial Regression Discontinuity Estimators.

## Syntax

```
rdbwselect depvar indepvar [if] [in] [, c(#) fuzzy(fuzzyvar [sharpbw]) deriv(#)
p(#) q(#) covs(covars) covs_drop(covsdropoption) kernel(kernelfn)
weights(weightsvar) bwselect(bwmethod) all scaleregul(#)
masspoints(masspointsoption) bwcheck(bwcheck) bwrestrict(bwropt)
stdvars(stdopt) vce(vcetype [vceopt1 vceopt2]) ]
```

## Description

**rdbwselect** implements bandwidth selectors for local polynomial Regression Discontinuity (RD) point estimators and inference procedures developed in [Calonico, Cattaneo and Titiunik \(2014a\)](#), [Calonico, Cattaneo and Farrell \(2018\)](#), [Calonico, Cattaneo, Farrell and Titiunik \(2019\)](#), and [Calonico, Cattaneo and Farrell \(2020\)](#).

Companion commands are: [rdrobust](#) for point estimation and inference procedures, and [rdplot](#) for data-driven RD plots (see [Calonico, Cattaneo and Titiunik \(2015a\)](#) for details).

A detailed introduction to this command is given in [Calonico, Cattaneo and Titiunik \(2014b\)](#), and [Calonico, Cattaneo, Farrell and Titiunik \(2017\)](#). A companion R package is also described in [Calonico, Cattaneo and Titiunik \(2015b\)](#).

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

<https://rdpackages.github.io/>

## Options

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Estimand

**c(#)** specifies the RD cutoff for *indepvar*. Default is **c(0)**.

**fuzzy(fuzzyvar [sharpbw])** specifies the treatment status variable used to implement fuzzy RD estimation (or Fuzzy Kink RD if **deriv(1)** is also specified). Default is Sharp RD design and hence this option is not used. If the option *sharpbw* is set, the fuzzy RD estimation is performed using a bandwidth selection procedure for the sharp RD model. This option is automatically selected if there is perfect compliance at either side of the threshold.

**deriv(#)** specifies the order of the derivative of the regression functions to be estimated. Default is **deriv(0)** (for Sharp RD, or for Fuzzy RD if **fuzzy(.)** is also specified). Setting **deriv(1)** results in estimation of a Kink RD design (up to scale), or Fuzzy Kink RD if **fuzzy(.)** is also specified.

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Local Polynomial Regression

**p(#)** specifies the order of the local polynomial used to construct the point estimator. Default is **p(1)** (local linear regression).

**q(#)** specifies the order of the local polynomial used to construct the bias correction. Default is **q(2)** (local quadratic regression).

**covs(covars)** specifies additional covariates to be used for estimation and inference.

**covs\_drop**(*covsdropoption*) assess collinearity in additional covariates used for estimation and inference. Options **pinv** (default choice) and **invsym** drops collinear additional covariates, differing only in the type of inverse function used. Option **off** only checks collinear additional covariates but does not drop them.

**kernel**(*kernelfn*) specifies the kernel function used to construct the local-polynomial estimator(s). Options are: **triangular**, **epanechnikov**, and **uniform**. Default is **kernel(triangular)**.

**weights**(*weightsvar*) is the variable used for optional weighting of the estimation procedure. The unit-specific weights multiply the kernel function.

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### Bandwidth Selection

**bwselect**(*bwmeth*) specifies the bandwidth selection procedure to be used.

Options are:

**mserd** one common MSE-optimal bandwidth selector for the RD treatment effect estimator.

**msetwo** two different MSE-optimal bandwidth selectors (below and above the cutoff) for the RD treatment effect estimator.

**msesum** one common MSE-optimal bandwidth selector for the sum of regression estimates (as opposed to difference thereof).

**msecomb1** for min(**mserd**, **msesum**).

**msecomb2** for median(**msetwo**, **mserd**, **msesum**), for each side of the cutoff separately.

**cerd** one common CER-optimal bandwidth selector for the RD treatment effect estimator.

**certwo** two different CER-optimal bandwidth selectors (below and above the cutoff) for the RD treatment effect estimator.

**cersum** one common CER-optimal bandwidth selector for the sum of regression estimates (as opposed to difference thereof).

**cercomb1** for min(**cerd**, **cersum**).

**cercomb2** for median(**certwo**, **cerd**, **cersum**), for each side of the cutoff separately.

Note: MSE = Mean Square Error; CER = Coverage Error Rate.

Default is **bwselect(mserd)**. For details on implementation see [Calonico, Cattaneo and Titiunik \(2014a\)](#), [Calonico, Cattaneo and Farrell \(2018\)](#), [Calonico, Cattaneo, Farrell and Titiunik \(2019\)](#), and [Calonico, Cattaneo and Farrell \(2020\)](#), and the companion software articles.

**all** if specified, **rdbwselect** reports all available bandwidth selection procedures.

**scaleregul**(#) specifies scaling factor for the regularization term added to the denominator of the bandwidth selectors. Setting **scaleregul(0)** removes the regularization term from the bandwidth selectors. Default is **scaleregul(1)**.

**masspoints**(*masspointsoption*) checks and controls for repeated observations in the running variable. Options are:

**off** ignores the presence of mass points.

**check** looks for and reports the number of unique observations at each side of the cutoff.

**adjust** controls that the preliminary bandwidths used in the calculations contain a minimal number of unique observations. By default it uses 10 observations, but it can be manually adjusted with the option **bwcheck**.

Default option is **masspoints(adjust)**.

**bwcheck**(*bwcheck*) if a positive integer is provided, the preliminary bandwidth used in the calculations is enlarged so that at least *bwcheck* unique observations are used.

**bwrestrict**(*bwropt*) if set **on**, computed bandwidths are restricted to lie within the range of *runvar*. Default is **on**.

**stdvars**(*stdopt*) if set **on**, *depvar* and *runvar* are standardized before computing the bandwidths. Default is **off**.

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### Variance-Covariance Estimation

**vce**(*vcetype* [*vceopt1* *vceopt2*]) specifies the procedure used to compute the variance-covariance matrix estimator. Options are:

- vce**(**nn** [*nnmatch*]) for heteroskedasticity-robust nearest neighbor variance estimator with *nnmatch* indicating the minimum number of neighbors to be used.
- vce**(**hc0**) for heteroskedasticity-robust plug-in residuals variance estimator without weights.
- vce**(**hc1**) for heteroskedasticity-robust plug-in residuals variance estimator with *hc1* weights.
- vce**(**hc2**) for heteroskedasticity-robust plug-in residuals variance estimator with *hc2* weights.
- vce**(**hc3**) for heteroskedasticity-robust plug-in residuals variance estimator with *hc3* weights.
- vce**(**nncluster** *clustervar* [*nnmatch*]) for cluster-robust nearest neighbor variance estimation using with *clustervar* indicating the cluster ID variable and *nnmatch* matches indicating the minimum number of neighbors to be used.
- vce**(**cluster** *clustervar*) for cluster-robust plug-in residuals variance estimation with degrees-of-freedom weights and *clustervar* indicating the cluster ID variable.

Default is **vce**(**nn** 3).

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#### Example: Cattaneo, Frandsen and Titiunik (2015) Incumbency Data

```

Setup
. use rdrobust_senate.dta

MSE bandwidth selection procedure
. rdbwselect vote margin

All bandwidth bandwidth selection procedures
. rdbwselect vote margin, all

```

#### Stored results

**rdbwselect** stores the following in **e()**:

Scalars	
<b>e(N_l)</b>	number of observations to the left of the cutoff
<b>e(N_r)</b>	number of observations to the right of the cutoff
<b>e(c)</b>	cutoff value
<b>e(p)</b>	order of the polynomial used for estimation of the regression function
<b>e(q)</b>	order of the polynomial used for estimation of the bias of the regression function estimator
<b>e(h_mserd)</b>	MSE-optimal bandwidth selector for the RD treatment effect estimator.
<b>e(h_msetwo_l)</b>	MSE-optimal bandwidth selectors below the cutoff for the RD treatment effect estimator.
<b>e(h_msetwo_r)</b>	MSE-optimal bandwidth selectors above the cutoff for the RD treatment effect estimator.
<b>e(h_msesum)</b>	MSE-optimal bandwidth selector for the sum of regression estimates.
<b>e(h_msecomb1)</b>	for min( <b>mserd</b> , <b>msesum</b> ).
<b>e(h_msecomb2_l)</b>	for median( <b>msetwo</b> , <b>mserd</b> , <b>msesum</b> ), below the cutoff.
<b>e(h_msecomb2_r)</b>	for median( <b>msetwo</b> , <b>mserd</b> , <b>msesum</b> ), above the cutoff.

<b>e(h_cerrd)</b>	CER-optimal bandwidth selector for the RD treatment effect estimator.
<b>e(h_certwo_l)</b>	CER-optimal bandwidth selectors below the cutoff for the RD treatment effect estimator.
<b>e(h_certwo_r)</b>	CER-optimal bandwidth selectors above the cutoff for the RD treatment effect estimator.
<b>e(h_cersum)</b>	CER-optimal bandwidth selector for the sum of regression estimates.
<b>e(h_cercomb1)</b>	for min( <b>cerrd</b> , <b>cersum</b> ) .
<b>e(h_cercomb2_l)</b>	for median( <b>certwo_l</b> , <b>cerrd</b> , <b>cersum</b> ) , below the cutoff.
<b>e(h_cercomb2_r)</b>	for median( <b>certwo_r</b> , <b>cerrd</b> , <b>cersum</b> ) , above the cutoff.
<b>e(b_mserd)</b>	MSE-optimal bandwidth selector for the bias of the RD treatment effect estimator.
<b>e(b_msetwo_l)</b>	MSE-optimal bandwidth selectors below the cutoff for the bias of the RD treatment effect estimator.
<b>e(b_msetwo_r)</b>	MSE-optimal bandwidth selectors above the cutoff for the bias of the RD treatment effect estimator.
<b>e(b_msesum)</b>	MSE-optimal bandwidth selector for the sum of regression estimates for the bias of the RD treatment effect estimator.
<b>e(b_msecomb1)</b>	for min( <b>mserd</b> , <b>msesum</b> ) .
<b>e(b_msecomb2_l)</b>	for median( <b>msetwo</b> , <b>mserd</b> , <b>msesum</b> ) , below the cutoff.
<b>e(b_msecomb2_r)</b>	for median( <b>msetwo</b> , <b>mserd</b> , <b>msesum</b> ) , above the cutoff.
<b>e(b_cerrd)</b>	CER-optimal bandwidth selector for the bias of the RD treatment effect estimator.
<b>e(b_certwo_l)</b>	CER-optimal bandwidth selectors below the cutoff for the bias of the RD treatment effect estimator.
<b>e(b_certwo_r)</b>	CER-optimal bandwidth selectors above the cutoff for the bias of the RD treatment effect estimator.
<b>e(b_cersum)</b>	CER-optimal bandwidth selector for the sum of regression estimates for the bias of the RD treatment effect estimator.
<b>e(b_cercomb1)</b>	for min( <b>cerrd</b> , <b>cersum</b> ) .
<b>e(b_cercomb2_l)</b>	for median( <b>certwo_l</b> , <b>cerrd</b> , <b>cersum</b> ) , below the cutoff.
<b>e(b_cercomb2_r)</b>	for median( <b>certwo_r</b> , <b>cerrd</b> , <b>cersum</b> ) , above the cutoff.

#### Macros

<b>e(runningvar)</b>	name of running variable
<b>e(outcomevar)</b>	name of outcome variable
<b>e(clustvar)</b>	name of cluster variable
<b>e(covs)</b>	name of covariates
<b>e(vce_select)</b>	vcetype specified in vce()
<b>e(bwselect)</b>	bandwidth selection choice
<b>e(kernel)</b>	kernel choice

#### References

- Calonico, S., M. D. Cattaneo, and M. H. Farrell. 2020. Optimal Bandwidth Choice for Robust Bias Corrected Inference in Regression Discontinuity Designs. *Econometrics Journal* 23(2): 192-210.
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