



## Title

**rdbwdensity** — Bandwidth Selection for Manipulation Testing Using Local Polynomial Density Estimation.

## Syntax

```
rdbwdensity Var [if] [in] [,
    c(#) p(#) kernel(KernelFn) fitselect(FitMethod) vce(VceMethod)
    nomasspoints
    nlocalmin(#) nuniquemin(#) noregularize
    ]
```

## Description

**rdbwdensity** implements several data-driven bandwidth selection methods useful to construct manipulation testing procedures using the local polynomial density estimators proposed in Cattaneo, Jansson and Ma (2020).

A detailed introduction to this Stata command is given in Cattaneo, Jansson and Ma (2018). Companion R functions are also available [here](#).

Companion function is **rddensity**. See also the **lpdensity** package for other related bandwidth selection methods.

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

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

## Options

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Bandwidth Selection

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**c**(#) specifies the threshold or cutoff value in the support of *Var*, which determines the two samples (e.g., control and treatment units in RD settings). Default is **c(0)**.

**p**(#) specifies the local polynomial order used to construct the density estimators. Default is **p(2)** (local quadratic approximation).

**fitselect**(*FitMethod*) specifies the density estimation method.

- unrestricted** for density estimation without any restrictions (two-sample, unrestricted inference). This is the default option.
- restricted** for density estimation assuming equal distribution function and higher-order derivatives.

**kernel**(*KernelFn*) specifies the kernel function used to construct the local polynomial estimators.

- triangular**  $K(u) = (1 - |u|) * (|u| \leq 1)$ . This is the default option.
- epanechnikov**  $K(u) = 0.75 * (1 - u^2) * (|u| \leq 1)$ .
- uniform**  $K(u) = 0.5 * (|u| \leq 1)$ .

**vce**(*VceMethod*) specifies the procedure used to compute the variance-covariance matrix estimator.

- plugin** for asymptotic plug-in standard errors.
- jackknife** for jackknife standard errors. This is the default option.

**nomasspoints** will not adjust for mass points in the data.

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Local Sample Size Checking

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**nlocalmin**(#) specifies the minimum number of observations in each local neighborhood. This option will be ignored if set to 0, or if **noregularize** is used. The default value is **20+p(#)+1**.

**nuniquemin(#)** specifies the minimum number of unique observations in each local neighborhood. This option will be ignored if set to 0, or if **noregularize** is used. The default value is **20+p(#)+1**.

**noregularize** suppresses the local sample size checking feature.

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

Load dataset (cutoff is 0 in this dataset):

```
. use rddensity_senate.dta
```

Bandwidth selection for manipulation test using default options:

```
. rdbwdensity margin
```

Bandwidth selection for manipulation test using plug-in standard errors:

```
. rdbwdensity margin, vce(plugin)
```

#### **Saved results**

**rddensity** saves the following in **e()**:

Macros

<b>e(c)</b>	cutoff value
<b>e(p)</b>	order of the polynomial used for density estimation
<b>e(N_l)</b>	sample size to the left of the cutoff
<b>e(N_r)</b>	sample size to the right of the cutoff
<b>e(h)</b>	matrix of estimated bandwidth (including underlying estimated constants)
<b>e(runningvar)</b>	running variable used
<b>e(kernel)</b>	kernel used
<b>e(fitmethod)</b>	model used
<b>e(vce)</b>	standard errors estimator used

#### **References**

Cattaneo, M. D., B. Frandsen, and R. Titiunik. 2015. Randomization Inference in the Regression Discontinuity Design: An Application to the Study of Party Advantages in the U.S. Senate. *Journal of Causal Inference* 3(1): 1-24.

Cattaneo, M. D., M. Jansson, and X. Ma. 2018. Manipulation Testing based on Density Discontinuity. *Stata Journal* 18(1): 234-261.

Cattaneo, M. D., M. Jansson, and X. Ma. 2020. Simple Local Polynomial Density Estimators. *Journal of the American Statistical Association* 115(531): 1449-1455.

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