



## Title

**fan\_park** — Sharp Bounds on the Distribution of Treatment Effects.

## Syntax

```
fan_park depvar treatvar [indepvars] [if] [in] [, delta_partition(#)
delta_values(numlist) cov_partition(#) level(#) nograph seed(#) qbounds
num_quantiles(#) ]
```

## Description

**fan\_park** implements nonparametric estimators, and inference, of sharp bounds on the distribution of treatment effects of a binary treatment developed in [Fan, and Park \(2009\)](#).

Let  $\Delta = Y_1 - Y_0$  denote the treatment effect or outcome gain, and  $F_{\Delta}(\cdot)$  its distribution function. Given the marginals  $F_1$  and  $F_0$  we can compute sharp bounds on the distribution of  $\Delta$  for each  $x$  in the support of  $F_{\Delta}$ , that is :  $F_L(x) \leq F_{\Delta}(x) \leq F_U(x)$ . Alternatively, when the option **qbounds** is given, **fan\_park** computes bounds for the quantile function :  $F_U^{-1}(q) \leq F_{\Delta}^{-1}(q) \leq F_L^{-1}(q)$ .

## Arguments

### Arguments

*depvar*, this is the outcome of interest. Results are more meaningful when outcome is a continuous variable, but it also works for binary variables.

*treatvar*, binary (0-1) treatment variable.

[*indepvars*], varlist of independent variables. Factor or time series variables not allowed.

## Options

### Options

**delta\_partition**(#) specifies the number of points ( $x$ ) in an equally spaced partition of the support of the treatment effect ( $Y_1 - Y_0$ ). Default is **delta\_partition(100)**.

**delta\_values**(*numlist*) specifies the points ( $x$ ) where the bounds are computed. If this option is specified, then it supercedes the option **delta\_partition**(#).

**cov\_partition**(#), when covariates are provided, it specifies the number of clusters in a kmedians algorithm to partition the covariate space. Covariates are used to tighten the bounds. Default is **cov\_partition(6)**

**level**(#) specifies the significance level for the confidence intervals. Default is **level(95)**

**nograph**, if specified omits display of graph.

**seed**(#) sets the seed for the kmedians initialization for the partition of the covariate space.

**qbounds**, when specified, this options computes bounds for the quantile treatment effect function. We do not provide confidence intervals for the quantile function bounds. In practice this is computationally more efficient and can be combined with permutation inference like bootstrapping.

**num\_quantiles**(#) specifies the number of quantiles ( $q$ ) in an equally spaced partition of  $[0,1]$ . Default is **num\_quantiles(100)**

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### Examples

#### "The limits of self-commitment and private paternalism"

```

Setup
  use limits_commitment.dta, clear

Average treatment effect
  regress apr treat, robust

Bounds for the treatment effect
  fan_park apr treat

Bounds for the quantile-treatment effect
  fan_park apr treat, qbounds

```

### Simulation Example

```
do simulation_fan_park.do
```

### Stored results

**rdrobust** stores the following in **r()**:

#### Matrices

<b>r(bounds)</b>	matrix of size (n X 2) where n denotes the number of points where the bounds are computed. The first column stores the estimated lower bound, while the second column stores the upper bound at each of the points. If option <b>qbounds</b> is provided <b>r(bounds)</b> stores the quantile bounds.
<b>r(sigma_2)</b>	matrix of size (n X 2). First column denotes the estimated variance for the lower bound at each of the points provided, and the second column stores the estimated variance for the upper bound.
<b>r(M_delta)</b>	matrix of size (n X 2). First column stores $M(\delta) = \sup\{F_1(y) - F_0(y - \delta)\}$ , and second column stores $m(\delta) = \inf\{F_1(y) - F_0(y - \delta)\}$ . For further details, see Fan, and Park (2009).
<b>r(delta_val)</b>	matrix of size (n X 1). Stores the points in the support of $(Y_1 - Y_0)$ where the bounds are computed
<b>r(q_val)</b>	matrix of size (n X 1). Stores the quantiles used to compute the q-bounds.

### References

Fan, Yangin, and Sang Soo Park. "SHARP BOUNDS ON THE DISTRIBUTION OF TREATMENT EFFECTS AND THEIR STATISTICAL INFERENCE." *Econometric Theory*, vol. 26, no. 3, 2010, pp. 931-51.

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