

## Title

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**persuasio4yz** — Conduct causal inference on persuasive effects for binary outcomes  $y$  and binary instruments  $z$

## Syntax

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```
persuasio4yz depvar instrvar [covariates] [if] [in] [, level(#)  
model(string) method(string) nboot(#) title(string)]
```

## Options

<i>option</i>	<i>Description</i>
<b>level</b> (#)	Set confidence level; default is <b>level</b> (95)
<b>model</b> ( <i>string</i> )	Regression model when <i>covariates</i> are present
<b>method</b> ( <i>string</i> )	Inference method; default is <b>method</b> ("normal")
<b>nboot</b> (#)	Perform # bootstrap replications
<b>title</b> ( <i>string</i> )	Title

## Description

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**persuasio4yz** conducts causal inference on persuasive effects.

It is assumed that binary outcomes  $y$  and binary instruments  $z$  are observed. This command is for the case when persuasive treatment ( $t$ ) is unobserved, using an estimate of the lower bound on the average persuasion rate (APR) via this package's command **aprlb**.

*varlist* should include *depvar instrvar covariates* in order. Here, *depvar* is binary outcomes ( $y$ ), *instrvar* is binary instruments ( $z$ ), and *covariates* ( $x$ ) are optional.

When treatment  $t$  is unobserved, the upper bound on the APR is simply 1.

There are two cases: (i) *covariates* are absent and (ii) *covariates* are present.

- Without  $x$ , the lower bound (**theta\_L**) on the APR is defined by

$$\mathbf{theta\_L} = \{\Pr(y=1|z=1) - \Pr(y=1|z=0)\} / \{1 - \Pr(y=1|z=0)\}.$$

The estimate and confidence interval are obtained by the following procedure:

1.  $\Pr(y=1|z=1)$  and  $\Pr(y=1|z=0)$  are estimated by regressing  $y$  on  $z$ .
2. **theta\_L** is computed using the estimates obtained above.
3. The standard error is computed via STATA command **nlcom**.
4. Then, a confidence interval for the APR is set by

$$[ \text{est} - \text{cv} * \text{se} , 1 ],$$

where  $\text{est}$  is the estimate,  $\text{se}$  is the standard error, and  $\text{cv}$  is the one-sided standard normal critical value (e.g.,  $\text{cv} = 1.645$  for **level**(95)).

- With  $x$ , the lower bound (**theta\_L**) on the APR is defined by

$$\mathbf{theta\_L} = E[\mathbf{theta\_L}(x)],$$

where

$$\mathbf{theta\_L}(x) = \{\Pr(y=1|z=1,x) - \Pr(y=1|z=0,x)\} / \{1 - \Pr(y=1|z=0,x)\}.$$

The estimate is obtained by the following procedure.

If **model**("no\_interaction") is selected (default choice),

1.  $\Pr(y=1|z,x)$  is estimated by regressing  $y$  on  $z$  and  $x$ .

Alternatively, if **model**("interaction") is selected,

- 1a.  $\Pr(y=1|z=1,x)$  is estimated by regressing  $y$  on  $x$  given  $z = 1$ .
- 1b.  $\Pr(y=1|z=0,x)$  is estimated by regressing  $y$  on  $x$  given  $z = 0$ .

Ater step 1, both options are followed by:

2. For each  $x$  in the estimation sample, **theta\_L\_num**( $x$ ) and **theta\_L\_den**( $x$ ) are evaluated.
3. The estimates of **theta\_L\_num**( $x$ ) and **theta\_L\_den**( $x$ ) are averaged to estimate **theta\_L**.
4. A bootstrap confidence interval for the APR is set by

$$[ \text{bs\_est}(\alpha) , 1 ],$$

where  $\text{bs\_est}(\alpha)$  is the  $\alpha$  quantile of the bootstrap estimates of **theta\_L** and  $1 - \alpha$  is the confidence level.

The bootstrap procedure is implemented via STATA command **bootstrap**.

## **Options**

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**model**(*string*) specifies a regression model of  $y$  on  $z$  and  $x$ .

This option is only relevant when  $x$  is present. The default option is "no\_interaction" between  $z$  and  $x$ . When "interaction" is selected, full interactions between  $z$  and  $x$  are allowed; this is accomplished by estimating  $\Pr(y=1|z=1,x)$  and  $\Pr(y=1|z=0,x)$ , separately.

**level**(#) sets confidence level; default is **level**(95).

**method**(*string*) refers the method for inference.

The default option is **method**("normal"). By the nature of identification, one-sided confidence intervals are produced.

1. When  $x$  is present, it needs to be set as **method**("bootstrap"); otherwise, the confidence interval will be missing.
2. When  $x$  is absent, both options yield non-missing confidence intervals.

**nboot**(#) chooses the number of bootstrap replications.

The default option is **nboot**(50). It is only relevant when **method**("bootstrap") is selected.

**title**(*string*) specifies a title.

## **Remarks**

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It is recommended to use **nboot**(#) with # at least 1000. A default choice of 50 is meant to check the code initially because it may take a long time to run the bootstrap part. The bootstrap confidence interval is based on percentile bootstrap. Normality-based bootstrap confidence interval is not recommended because bootstrap standard errors can be unreasonably large in applications.

## **Examples**

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We first call the dataset included in the package.

```
. use GKB, clear
```

The first example conducts inference on the APR without covariates, using normal approximation.

```
. persuasio4yz voteddem_all post, level(80) method("normal")
```

The second example conducts bootstrap inference on the APR.

```
. persuasio4yz voteddem_all post, level(80) method("bootstrap")  
nboot(1000)
```

The third example conducts bootstrap inference on the APR with a covariate, MZwave2, interacting with the instrument, post.

```
. persuasio4yz voteddem_all post MZwave2, level(80) model("interaction")  
method("bootstrap") nboot(1000)
```

## **Stored results**

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### **Matrices**

**e(apr\_est):** (1\*2 matrix) bounds on the average persuasion rate in the form of [lb, 1]

**e(apr\_ci):** (1\*2 matrix) confidence interval for the average persuasion rate in the form of [lb\_ci, 1]

### **Macros**

**e(cilevel):** confidence level

**e(inference\_method):** inference method: "normal" or "bootstrap"

## **Authors**

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## **License**

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## **References**

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Sung Jae Jun and Sokbae Lee (2022), Identifying the Effect of Persuasion, [arXiv:1812.02276](https://arxiv.org/abs/1812.02276) [[econ.EM](#)].

## **Version**

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