

Package ‘GMMsensitivity’

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Title Confidence intervals for sensitivity analysis in GMM

Version 0.1.1

Description Construct confidence intervals in generalized method of moments (GMM) models that are valid under local misspecification.

Depends R (>= 4.0.0)

License GPL-3

Encoding UTF-8

Suggests spelling,
testthat,
knitr,
CVXR,
rmarkdown

Imports stats

RoxygenNote 7.1.1

VignetteBuilder knitr

LazyData true

Language en-US

URL <https://github.com/kolesarm/GMMsensitivity/>

BugReports <https://github.com/kolesarm/GMMsensitivity/issues>

R topics documented:

blp	2
EffBounds	3
Jtest	4
lph	5
OptEstimator	6
Index	8

blp

*Estimates from Berry, Levinsohn, and Pakes (1995)***Description**

This dataset contains estimates of the model in Berry, Levinsohn, and Pakes (1995), as implemented by Andrews, Gentzkow, and Shapiro (2017), and it is used to illustrate the confidence intervals implemented in this package.

Usage

blp

Format

A list, consisting 11 objects:

G Matrix with 31 rows and 17 columns, estimate of derivative of the moment condition evaluated at initial estimate of θ from Berry, Levinsohn, and Pakes (1995), $\hat{\theta}$.

H Vector of length 17, estimate of derivative of average markup $h(\theta)$ with respect to model parameters θ , evaluated at $\hat{\theta}$.

W Weight matrix used to obtain the estimate $\hat{\theta}$.

g_init Average moment condition, evaluated at $\hat{\theta}$.

h_init Estimate of the average markup, $h(\hat{\theta})$.

names Two lists, one for names of the moment conditions, and one for elements of θ .

ZZ Gram matrix $Z'Z$ of the instruments, used to specify the misspecification set C .

Sig Estimate of variance of moment condition.

sdZ Vector of standard deviations of the instruments.

perturb scaling parameters to give interpretable meaning to violations of supply-side conditions. See vignette vignette("GMMsensitivity", package="GMMsensitivity") for details.

n Sample size, number of model/years.

See Armstrong and Kolesár (2018) for a detailed description of these objects.

Source

Replication files for Andrews, Gentzkow, and Shapiro (2017), available at <https://doi.org/10.7910/DVN/LLARSN>

References

- Andrews, I., M. Gentzkow, and J. M. Shapiro (2017): *Measuring the Sensitivity of Parameter Estimates to Sample Statistics*, *Quarterly Journal of Economics*, 132, 1553–1592.
- Armstrong, T. B., and M. Kolesár (2018): *Sensitivity Analysis Using Approximate Moment Condition Models*, *Unpublished manuscript*
- Berry, S. T., J. Levinsohn, and A. Pakes (1995): *Automobile Prices in Market Equilibrium*, *Econometrica*, 63, 841–890.

EffBounds

Efficiency bounds under ℓ_p constraints

Description

Computes the asymptotic efficiency of two-sided fixed-length confidence intervals at $c = 0$, as well as the efficiency of one-sided confidence intervals that optimize a given beta quantile of excess length, when the set C is characterized by ℓ_p constraints.

Usage

```
EffBounds(eo, B, M, p = 2, beta = 0.5, alpha = 0.05, cvx = FALSE)
```

Arguments

eo	<p>List containing initial estimates with the following components:</p> <p>Sig Estimate of variance of the moment condition, matrix with dimension d_g by d_g, where d_g is the number of moments</p> <p>G Estimate of derivative of the moment condition, matrix with dimension d_g by d_θ, where d_θ is the dimension of θ</p> <p>H Estimate of derivative of $h(\theta)$. A vector of length d_θ</p> <p>n sample size</p> <p>h_init Estimate of $h(\theta)$</p> <p>k_init Initial sensitivity</p> <p>g_init Moment condition evaluated at initial estimate</p>
B	matrix B with full rank and dimension d_g by d_γ that determines the set C , where d_γ is the number of invalid moments, and d_g is the number of moments
M	Bound on the norm of γ
p	Parameter determining which ℓ_p norm to use, must equal 1, 2, or Inf.
beta	Quantile of excess length that a one-sided confidence interval is optimizing.
alpha	determines confidence level, $1 - \alpha$, for constructing/optimizing confidence intervals.
cvx	By default, the efficiency for $p=1$ and for $p=\text{Inf}$ is computed using the homotopy algorithm described in Appendix A of Armstrong and Kolesár (2018). If $\text{cvx}=\text{TRUE}$ is specified, the modulus is computed using the CVX convex optimizer. This option is included mostly just to verify that the homotopy solution correct.

Details

The set C takes the form $B\gamma$ where the ℓ_p norm of γ is bounded by M .

References

Armstrong, T. B., and M. Kolesár (2018): *Sensitivity Analysis Using Approximate Moment Condition Models*, Unpublished manuscript

Jtest	<i>J-test of overidentifying restrictions under local misspecification</i>
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Description

Computes J-test of overidentifying restrictions with critical value adjusted to allow for local misspecification, when the parameter c takes the form $c = B\gamma$ with the ℓ_p norm of γ bounded by M . Assumes initial estimator in `eo` is optimal under correct specification.

Usage

```
Jtest(eo, B, M, p = 2, alpha = 0.05)
```

Arguments

<code>eo</code>	List containing initial estimates with the following components: Sig Estimate of variance of the moment condition, matrix with dimension d_g by d_g , where d_g is the number of moments G Estimate of derivative of the moment condition, matrix with dimension d_g by d_θ , where d_θ is the dimension of θ H Estimate of derivative of $h(\theta)$. A vector of length d_θ n sample size h_init Estimate of $h(\theta)$ k_init Initial sensitivity g_init Moment condition evaluated at initial estimate
<code>B</code>	matrix B with full rank and dimension d_g by d_γ that determines the set C , where d_γ is the number of invalid moments, and d_g is the number of moments
<code>M</code>	Bound on the norm of γ
<code>p</code>	Parameter determining which ℓ_p norm to use, must equal 1, 2, or Inf.
<code>alpha</code>	determines confidence level, $1-\alpha$, for constructing/optimizing confidence intervals.

Value

List with three elements:

J Value of J statistic

p0 P-value of usual J test

pC P-value for J-test that allows for local misspecification

Mmin Minimum value of M for which the J-test would not reject

lph

Compute solution path for ℓ_∞ or ℓ_1 constraints

Description

Computes the vector of optimal sensitivities at each knot of the solution path that traces out the optimal bias-variance frontier when the set C takes the form $c = B\gamma$ with the ℓ_p norm of γ is bounded by a constant, for $p = 1$, or $p = \infty$. This path is used as an input to [OptEstimator](#).

Usage

lph(eo, B, p = Inf)

Arguments

eo	List containing initial estimates with the following components: Sig Estimate of variance of the moment condition, matrix with dimension d_g by d_g , where d_g is the number of moments G Estimate of derivative of the moment condition, matrix with dimension d_g by d_θ , where d_θ is the dimension of θ H Estimate of derivative of $h(\theta)$. A vector of length d_θ n sample size h_init Estimate of $h(\theta)$ k_init Initial sensitivity g_init Moment condition evaluated at initial estimate
B	matrix B with full rank and dimension d_g by d_γ that determines the set C , where d_γ is the number of invalid moments, and d_g is the number of moments
p	Parameter determining which ℓ_p norm to use, one of 1, or Inf.

Details

The algorithm is described in Appendix A of Armstrong and Kolesár (2018)

References

Armstrong, T. B., and M. Kolesár (2018): *Sensitivity Analysis Using Approximate Moment Condition Models*, Unpublished manuscript

OptEstimator

*One-step estimator based on optimal sensitivity under ℓ_p constraints***Description**

Computes the optimal sensitivity and the optimal estimator when the set C takes the form $c = B\gamma$ with the ℓ_p norm of γ bounded by M .

Usage

```
OptEstimator(
    eo,
    B,
    M,
    p = 2,
    spath = NULL,
    alpha = 0.05,
    opt.criterion = "FLCI"
)
```

Arguments

eo	List containing initial estimates with the following components: Sig Estimate of variance of the moment condition, matrix with dimension d_g by d_g , where d_g is the number of moments G Estimate of derivative of the moment condition, matrix with dimension d_g by d_θ , where d_θ is the dimension of θ H Estimate of derivative of $h(\theta)$. A vector of length d_θ n sample size h_init Estimate of $h(\theta)$ k_init Initial sensitivity g_init Moment condition evaluated at initial estimate
B	matrix B with full rank and dimension d_g by d_γ that determines the set C , where d_γ is the number of invalid moments, and d_g is the number of moments
M	Bound on the norm of γ
p	Parameter determining which ℓ_p norm to use, must equal 1, 2, or Inf.
spath	Optionally, the solution path, output of lph to speed up computation. For $p=1$ and $p=Inf$ only.
alpha	determines confidence level, $1-\alpha$, for constructing/optimizing confidence intervals.
opt.criterion	Optimality criterion for choosing optimal bias-variance tradeoff. The options are: "mse" Minimize worst-case mean squared error of the estimator.

"FLCI" Length of (fixed-length) two-sided confidence intervals.

"Valid" Optimal estimator under valid moments. This returns the original estimator, with confidence intervals adjusted for possible misspecification

Index

* **datasets**

blp, [2](#)

blp, [2](#)

EffBounds, [3](#)

Jtest, [4](#)

lph, [5](#)

OptEstimator, [5](#), [6](#)