TITLE

January 16, 2019

Title Confidence intervals for sensitivity analysis in GMM

Version 0.1.0

Description Implements optimal confidence intervals for sensitivity analysis in generalized method of moments (GMM) models.

Depends R (>= 3.4.0)

License GPL-3

Encoding UTF-8

LazyData true

Suggests spelling,
testthat,
knitr,
CVXR,
rmarkdown

RoxygenNote 6.1.1

VignetteBuilder knitr

Language en-US

URL `https://github.com/kolesarm/GMMSensitivity/`

BugReports `https://github.com/kolesarm/GMMSensitivity/issues`

R topics documented:

`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://dataverse.harvard.edu/file.xhtml?persistentId=doi:10.7910/DVN/LLARSN/2KFPRA&version=1.1

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Armstrong, T. B., and M. Kolesár (2018): Sensitivity Analysis Using Approximate Moment Condition Models, Unpublished manuscript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`	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`.
`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=Inf` is computed using the homotopy algorithm described in Appendix A of Armstrong and Kolesár (2018). If `cvx=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

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`Jtest` *J-test of overidentifying restrictions under local misspecification*

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

`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`.

`alpha` 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

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`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 ell_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

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