Package 'spefa'

May 28, 2026

Type Package

Title Spatial Stochastic Frontier with Fixed Effects and Endogeneity

Version 0.1.0

Description Maximum-likelihood estimation of the spatial autoregressive stochastic frontier model with individual fixed effects (removed by first differencing) and endogenous regressors handled through a Gaussian control function, as in Giannini (2025) <doi:10.1080/17421772.2024.2414962>. Returns coefficient estimates and standard errors, spatially-corrected technical (in)efficiency scores, and direct, indirect and total marginal impacts. Depends only on base R.

License GPL-3

Encoding UTF-8

Depends R (>= 3.5.0)

Imports stats

LazyData true

Suggests knitr, rmarkdown

VignetteBuilder knitr

RoxygenNote 7.2.3

NeedsCompilation no

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Repository CRAN

Date/Publication 2026-05-28 11:10:17 UTC

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`efficiency` *Technical (in)efficiency scores*

Description

Conditional-mean (JLMS) inefficiency estimates with optional spatial rescaling by $(I - \lambda W)^{-1}$.

Usage

```
efficiency(object, spatial = TRUE)
```

Arguments

`object`	a fitted `spefa` object.
`spatial`	logical; apply the spatial multiplier.

Value

A list with the inefficiency matrix `u` (N x T), efficiency `eff` = `exp(-u)`, and per-unit `Eu_i`.

Examples

```
data(spefademo)
fit <- spefa(y ~ x1 + q1, data = spefademo, index = c("id", "time"),
             W = spefaW, endogenous = list(q1 = ~ z1, q2 = ~ z2),
             scaling = ~ x2 + q2)
ef <- efficiency(fit)
summary(as.vector(ef$eff))
```

`impacts` *Direct, indirect and total marginal impacts (with inference)*

Description

LeSage-Pace decomposition of frontier marginal effects through the spatial multiplier $(I - \lambda W)^{-1}$. Standard errors, z-statistics and p-values are obtained by simulation from the asymptotic distribution of (β, λ).

Usage

```
impacts(object, ...)

## S3 method for class 'spefa'
impacts(object, R = 1000, seed = NULL, ...)
```

Arguments

`object`	a fitted `spefa` object.
`R`	number of simulation draws for the standard errors.
`seed`	optional integer seed for reproducibility.
`...`	unused.

Value

An object of class `impacts.spefa`: a list with matrices `Direct`, `Indirect` and `Total`, each with columns Estimate, Std.Error, z value and Pr(>|z|).

Examples

```
data(spefademo)
fit <- spefa(y ~ x1 + q1, data = spefademo, index = c("id", "time"),
             W = spefaW, endogenous = list(q1 = ~ z1, q2 = ~ z2),
             scaling = ~ x2 + q2)
impacts(fit, R = 500, seed = 1)
```

`spefa` *Spatial Stochastic Frontier with Fixed Effects and Endogeneity*

Description

Maximum-likelihood estimation of a spatial autoregressive stochastic frontier model with individual fixed effects (removed by first differencing) and endogenous regressors handled by a Gaussian control function.

Usage

```
spefa(formula, data, index, W, endogenous = NULL, scaling = NULL,
      mu = FALSE, control = list(maxit = 500, reltol = 1e-9))
```

Arguments

`formula`	frontier equation, e.g. `y ~ x1 + q1`. The intercept is removed by first differencing.
`data`	a balanced panel `data.frame`.
`index`	length-2 character vector `c(unit, time)`.
`W`	an N x N spatial weight matrix, rows/cols ordered by sorted unit id.
`endogenous`	named list mapping endogenous regressors to instruments, e.g. `list(q1 = ~ z1, q2 = ~ z2)`, or `NULL`.
`scaling`	one-sided formula of variables entering the inefficiency scaling $h_{it} = \exp(z_{it}'\phi)$, e.g. `~ x2 + q2`.
`mu`	logical; if `TRUE` estimate the truncation point (truncated-normal inefficiency), else half-normal.
`control`	list passed to `optim`.

Value

An object of class `spefa` with methods `summary`, `coef`, `vcov`, `logLik`, `efficiency` and `impacts`.

Examples

```
data(spefademo)
fit <- spefa(y ~ x1 + q1, data = spefademo, index = c("id", "time"),
             W = spefaW, endogenous = list(q1 = ~ z1, q2 = ~ z2),
             scaling = ~ x2 + q2)
summary(fit)
```

`spefademo` *Simulated demo panel for spefa*

Description

A small simulated balanced panel and its spatial weight matrix, used in the examples and vignette. Generated from the model in Giannini (2025) with $\beta = (0.5, 0.5)$, $\delta = (1, 1)$, $\phi = (0.3, 0.3)$, $\sigma^2_\varepsilon = 0.09$, $\sigma^2_v = 0.04$, $\rho = (0.5, 0.5)$, $\sigma^2_u = 0.09$ and $\lambda = 0.5$; `q1` and `q2` are endogenous, `q1` enters the frontier and `q2` the scaling.

Usage

```
data(spefademo)
```

Format

`spefademo`: a data.frame with 480 rows (N = 40 units, T = 12 periods) and columns `id`, `time`, `y`, `x1`, `x2`, `q1`, `q2`, `z1`, `z2`.

`spefaW`: a 40 x 40 row-normalised spatial weight matrix, ordered by `id`.

Examples

```
data(spefademo)
str(spefademo)
dim(spefaW)
```

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