Package 'sinar'

October 14, 2022

Title Conditional Least Squared (CLS) Method for the Model SINAR(1,1)

Version 0.1.0

Description Implementation of the Conditional Least Square (CLS) estimates and
its covariance matrix for the first-order spatial integer-valued
autoregressive model (SINAR(1,1)) proposed by Ghodsi (2012)
<doi:10.1080/03610926.2011.560739>.

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Imports MASS, stats, numDeriv

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

BugReports https://github.com/gilberto-sassi/sinar/issues

NeedsCompilation no

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Depends R (>= 3.5.0)

Repository CRAN

Date/Publication 2020-11-06 17:00:06 UTC

R topics documented:

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carabidae	*Counts of arthropods in a grid-sampled wheat field*

Description

A matrix with the counts of arthropods (carabidae) in a grid-sampled wheat field

Usage

```
data("carabidae")
```

Format

A matrix where each row and column is a count of carabidae species at the first cell.

Source

Kevin Wright (2020). agridat: Agricultural Datasets. R package version 1.17. https://CRAN.R-project.org/package=agridat

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cls	*Conditional least square estimates for a SINAR(1,1) process.*

Description

cls computes the conditional least square for a process described by

$$X_{i,j} = a_{10}X_{i-1,j} + a_{01}X_{i,j-1} + a_{11}X_{i-1,j-1} + \epsilon_{i,j}$$

where $\epsilon_{i,j}$ is an iid process with poison distribution. Note the a_{10}, a_{01}, a_{11} must belong to the interval $[0, 1]$. We obtain estimates for a_{10}, a_{01}, a_{11} and μ_ϵ. We do not make any asumption about the distribution of the innovation in the process.

Usage

```
cls(X)
```

Arguments

X A integer matrix where each cell is the observed value in the regular lattice.

Value

a vector with the estimates of $a_{10}, a_{01}, a_{11}, \mu$.

Examples

```
data("nematodes")
cls(nematodes)
```

---

emp_cov   *Empirical estimate for the Covariance matrix in the Klimko-Nelson.*

Description

Σ is the covariance matrix in the Klimko-Nelson seminal paper. Basically, we know

$$\sqrt{n}(\hat{a}_{10} - a_{10}, \hat{a}_{01} - a_{01}, \hat{a}_{11} - a_{11}, \hat{\mu}_\epsilon - \mu_\epsilon)^\top \sim MNV(0, \Sigma)$$

where

$$\Sigma = V^{-1}WV^{-1}.$$

For more details, check Klimko and Nelson (1978).

Usage

```
emp_cov(X)
```

Arguments

X   A integer matrix where each cell is the observed value in the regular lattice.

Value

The covariance matrix estimated empirically.

Examples

```
data("nematodes")
emp_cov(nematodes)
```

---

emp_V   *Empirical estimate for the matrix V in the Klimko-Nelson.*

Description

emp_V is the matrix in the Klimko-Nelson seminal paper. Basically, we know

$$\sqrt{n}(\hat{a}_{10} - a_{10}, \hat{a}_{01} - a_{01}, \hat{a}_{11} - a_{11}, \hat{\mu}_\epsilon - \mu_\epsilon)^\top \sim MNV(0, \Sigma)$$

where

$$\Sigma = V^{-1}WV^{-1}.$$

For more details, check Klimko and Nelson (1978).

Usage

```
emp_V(X)
```

Arguments

X   A integer matrix where each cell is the observed value in the regular lattice.

Value

The matrix V estimated empirically.

Examples

```
data("nematodes")
emp_V(nematodes)
```

---

emp_W   *Empirical estimate for the matrix W in the Klimko-Nelson.*

Description

emp_W is the matrix in the Klimko-Nelson seminal paper. Basically, we know

$$\sqrt{n}(\hat{a}_{10} - a_{10}, \hat{a}_{01} - a_{01}, \hat{a}_{11} - a_{11}, \hat{\mu}_\epsilon - \mu_\epsilon)^\top \sim MNV(0, \Sigma)$$

where

$$\Sigma = V^{-1}WV^{-1}.$$

For more details, check Klimko and Nelson (1978).

Usage

```
emp_W(X)
```

Arguments

X   A integer matrix where each cell is the observed value in the regular lattice.

Value

The matrix `W` estimated emprically.

Examples

```
data("nematodes")
emp_V(nematodes)
```

---

nematodes   *A matrix of counting data with 15 rows and 15 columns.*

Description

A matrix of counting data with 15 rows and 15 columns.

Usage

```
data("nematodes")
```

Format

Dataset of 15×15 regular grid on counts of cereal cyst-nematode (Heterodera avenae collected in soil core).

Source

PERRY, J. N. et al. SADIE: software to measure and model spatial pattern. Aspects of applied biology, v. 46, p. 95-102, 1996.

---

sinar_pois   *Simulating SINAR(1,1) process with innovations from a poison distribution.*

Description

`sinar_pois` returns a matrix representing a simulated regular lattice from a SINAR(1,1) process with innovations from a poison distribution.

Usage

```
sinar_pois(n_row, n_col, a10, a01, a11, l)
```

Arguments

n_row	Number of rows in the simulated lattice.
n_col	Number of columns in the simulated lattice.
a10	Coefficient from the element $X_{i-1,j}$.
a01	Coefficient from the element $X_{i,j-1}$.
a11	Coefficient from the element $X_{i-1,j-1}$.
l	Mean of the poison distribution used as innovations.

Details

This function simulates a regular lattice from the model

$$X_{i,j} = a_{10}X_{i-1,j} + a_{01}X_{i,j-1} + a_{11}X_{i-1,j-1} + \epsilon_{i,j}$$

where $\epsilon_{i,j}$ is an iid process with poison distribution. Note the a_{10}, a_{01}, a_{11} must belong to the interval $[0, 1]$.

Value

A integer matrix.

Examples

```
n_row <- 20
n_col <- 50
a10 <- 0.2
a01 <- 0.2
a11 <-  0.5
l <- 1
sinar_pois(n_row, n_col, a10, a01, a11, l)
```

---

teo_V   *Compute the value of matrix V using the coefficients.*

Description

V is the theoretical matrix from Klimko-Nelson for the SINAR(1,1) model. Basically, we know

$$\sqrt{n}(\hat{a}_{10} - a_{10}, \hat{a}_{01} - a_{01}, \hat{a}_{11} - a_{11}, \hat{\mu}_{\epsilon} - \mu_{\epsilon})^{\top} \sim MNV(0, \Sigma)$$

where

$$\Sigma = V^{-1}WV^{-1}.$$

For more details, check Klimko and Nelson (1978).

Usage

```
teo_V(a10, a01, a11, mu_e, s2_e)
```

Arguments

a10	is the parameter in the equation $X[i,j]a_{10}X[i-1,j]+a_{01}X[i,j-1]+a_{11}X[i-1,j-1]+\epsilon_{i,j}$
a01	is the parameter in the equation $X[i,j]a_{10}X[i-1,j]+a_{01}X[i,j-1]+a_{11}X[i-1,j-1]+\epsilon_{i,j}$
a11	is the parameter in the equation $X[i,j]a_{10}X[i-1,j]+a_{01}X[i,j-1]+a_{11}X[i-1,j-1]+\epsilon_{i,j}$
mu_e	is the mean of the innovations $\epsilon_{i,j}$
s2_e	is the standar deviation of the innovations $\epsilon_{i,j}$

Value

The matrix V estimated empirically.

Examples

```
n_row <- 20
n_col <- 50
a10 <- 0.2
a01 <- 0.2
a11 <-  0.5
l <- 1 # mean and variance for poison innovations

teo_V(a10, a01, a11, l, sqrt(l))
```

---

var_hat_sigma *Variance of standard deviation of epsilon.*

Description

$\hat{\sigma}_\epsilon$ is the standard deviation of $SINAR(1,1)$ model.

Usage

```
var_hat_sigma(X)
```

Arguments

X	A integer matrix where each cell is the observed value in the regular lattice.

Value

The variance of standard deviation of the estimate of σ_ϵ.

Examples

```
data("nematodes")
var_hat_sigma(nematodes)
```

---

var_sinar	*Empirical estimate for the variance of innovations.*

Description

σ_ϵ^2 is the variance the innovations for the $SINAR(1, 1)$ model.

Usage

```
var_sinar(X)
```

Arguments

X   A integer matrix where each cell is the observed value in the regular lattice.

Value

The estimated standard deviation in the $SINAR(1, 1)$.

Examples

```
data("nematodes")
var_sinar(nematodes)
```

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