

Package ‘sinar’

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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>](https://doi.org/10.1080/03610926.2011.560739).

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carabidae	<i>Counts of arthropods in a grid-sampled wheat field</i>
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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>

cls	<i>Conditional least square estimates for a SINAR(1,1) process.</i>
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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 poisson 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 assumption 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.
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Value

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

Examples

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

emp_cov	<i>Empirical estimate for the Covariance matrix in the Klimko-Nelson.</i>
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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

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

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	<i>Empirical estimate for the matrix V in the Klimko-Nelson.</i>
-------	--

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

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

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 empirically.

Examples

```
data("nematodes")
emp_W(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 poisson 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 poisson innovations

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

var_hat_sigma	<i>Variance of standard deviation of epsilon.</i>
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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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