Package 'copulaSFM'

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Type Package

Title Copula-Based Simultaneous Stochastic Frontier Models

Version 0.1.0

Description Provides estimation procedures for copula-based stochastic frontier models for cross-sectional data. The package implements maximum likelihood estimation of stochastic frontier models allowing flexible dependence structures between inefficiency and noise terms through various copula families (e.g., Gaussian and Student-t). It enables estimation of technical efficiency scores, log-likelihood values, and information criteria (AIC and BIC). The implemented framework builds upon stochastic frontier analysis introduced by Aigner, Lovell and Schmidt (1977) <doi:10.1016/0304-4076(77)90052-5> and the copula theory described in Joe (2014, ISBN:9781466583221). Empirical applications of copula-based stochastic frontier models can be found in Wiboonpongse et al. (2015) <doi:10.1016/j.ijar.2015.06.001> and Maneejuk et al. (2017, ISBN:9783319562176).

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Encoding UTF-8

RoxygenNote 7.3.3

Imports stats, graphics, truncnorm, VineCopula

NeedsCompilation no

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copSFM *Copula based Stochastic frontier Model*

Description

In the standard stochastic frontier model, the two-sided error term V and the one-sided technical inefficiency error term W are assumed to be independent. In this paper, we relax this assumption by modeling the dependence between V and W using copulas. Nine copula families are considered and their parameters are estimated using maximum simulated likelihood.

Usage

```
copSFM(Y,X,family,RHO,LB,UB,verbose = FALSE)
```

Arguments

Y	vector of dependent variable
X	matrix of independent variable
family	Copula function eg. Gaussain=1, Student-t=2 (see, Vinecopula package)
RHO	The initail value of the copula parameter
LB	The lower bound of the copula parameter
UB	The upper bound of the copula parameter
verbose	Logical; if TRUE, prints progress messages during optimization.

Details

herefore, the above copula families and relevant rotated copula can potentially capture the appropriate dependence between two random variables. Other popular copula families, such as Gaussain, Student,t Clayton, Gumbel etc.

Value

result	The result contain the estimated parameters, standard errors, t-stat, and p-value
AIC	Akaiki Information Criteria
BIC	Bayesian Information Criteria
Loglikelihood	Maximum Log-likelihood function

Author(s)

Woraphon Yamaka and Paravee MAneejuk

References

Wiboonpongse, A., Liu, J., Sriboonchitta, S., & Denoeux, T.(2015). Modeling dependence between error components of the stochastic frontier model using copula: application to intercrop coffee production in Northern Thailand. International Journal of Approximate Reasoning, 65, 34-44.

Maneejuk, P., Yamaka, W., & Sriboonchitta, S.(2017). Analysis of global competitiveness using copula-based stochastic frontier kink model. In Robustness in Econometrics (pp. 543-559). Springer, Cham.

Examples

```
#example simulation data
data=sfa.simu(nob=50, alpha=c(1,2,0.5),sigV=1,sigU=0.5,family=1,rho=0.5)

# Select familty  copula upper and lower bouubd ( look at CDVine package)
# family=1   # 1 is Gaussian, 2 is Student-t, 3 is Clayton and so on....

#Gaussian (-.99, .99)
#Student t (-.99, .99)
#Clayton (0.1, Inf)
model=copSFM(Y=data$Y,X=data$X,family=1,RHO=0.5,LB=-0.99,UB=0.99)
```

`sfa.simu` *Simulate Data for Stochastic Frontier Analysis*

Description

Simulates data for the copula-based stochastic frontier model.

Usage

```
sfa.simu(nob, alpha, sigV, sigU, family, rho)
```

Arguments

`nob`	Number of observations.
`alpha`	Coefficient vector.
`sigV`	Standard deviation of noise term V.
`sigU`	Standard deviation of inefficiency term U.
`family`	Copula family code.
`rho`	Copula dependence parameter.

Value

A list containing simulated output and inputs.

Examples

```
set.seed(1)
sim <- sfa.simu(nob = 20, alpha = c(1, 0.5, -0.2), sigV = 1, sigU = 1, family = 1, rho = 0.2)
```

TE1 *Technical efficiency measure.*

Description

Computing and plotting the technical efficiency.

Usage

```
TE1(theta,Y,X,family)
```

Arguments

theta	The estimated parameters form the model
Y	Vector of dependent variable
X	Matrix of independent variable
family	Copula function eg. Gaussain=1, Student-t=2 (see, Vinecopula package)

Details

Computing and plotting the technical efficiency.

Value

Output Technical efficiency series.

plot Plot of technical efficiency.

Author(s)

Woraphon Yamaka

References

Wiboonpongse, A., Liu, J., Sriboonchitta, S., & Denoeux, T. (2015). Modeling dependence between error components of the stochastic frontier model using copula: application to intercrop coffee production in Northern Thailand. International Journal of Approximate Reasoning, 65, 34-44.

Examples

```
## Required packages
#example simulation data
data=sfa.simu(nob=50, alpha=c(1,2,0.5),sigV=1,sigU=0.5,family=1,rho=0.5)

# Select familty  copula upper and lower bouubd ( look at CDVine package)
# family=1   # 1 is Gaussian, 2 is Student-t, 3 is Clayton and so on....

#Gaussian (-.99, .99)
#Student t (-.99, .99)
#Clayton (0.1, Inf)

model=copSFM(Y=data$Y,X=data$X,family=1,RHO=0.5,LB=-0.99,UB=0.99)

#EX: Plot the technical efficiency
te1=TE1(model$result[,1],Y=data$Y,X=data$X,family=1)
```

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