Package 'SimEUCartelLaw'

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Type Package

Title Simulation of Legal Exemption System for European Cartel Law

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Description Monte Carlo simulations of a game-theoretic model for the legal exemption system of the European cartel law are implemented in order to estimate the (mean) deterrent effect of this system. The input and output parameters of the simulated cartel opportunities can be visualized by three-dimensional projections. A description of the model is given in Moritz et al. (2018) <doi:10.1515/bejeap-2017-0235>.

Depends R (>= 3.2.0)

Suggests knitr, rmarkdown

Imports plot3D, stats

License GPL (>= 2)

LazyLoad yes

NeedsCompilation yes

RoxygenNote 6.0.1

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R topics documented:

`aggResults` *Aggregate results of the legal exemption game simulation*

Description

`aggResults` aggregates the results of `LEgame`.

Usage

```
aggResults(res)
```

Arguments

`res`	dataframe containing results of simulation using `LEgame`.

Details

`aggResults` aggregates the results of `LEgame` to a matrix containing information about the fractions for the potential equilibria as well as the means and standard deviations of the error probabilities, the compliance level, and the expected illegal gains.

Value

A matrix containing the aggregated results.

Examples

```
Par <- list(Phi=c(0.1,0.5), Rho=c(0.5,0.9), Ksi=c(0.05,0.3), Chi=c(0.1,0.4),
            M=c(0.2,1.2), G=c(0.05,0.2), A=c(0.1,0.3))
res <- LEgame(params=Par, m=100000)
print(aggResults(res))
```

`corrStruct` *Matrix containing the correlation structure*

Description

`corrStruct` contains the correlation structure of the input parameters.

Usage

```
corrStruct
```

Format

An object of class `matrix` with 7 rows and 7 columns.

Details

`corrStruct` contains the correlation structure of the input parameters. The actual correlation matrix used in the simulation is calculated as the corresponding identity maxtrix + r times this matrix.

CorrStudy *Investigate the effect of correlated input parameters*

Description

`CorrStudy` investigates the effect of correlated input parameters

Usage

```
CorrStudy(params, m = 1e+05, rho = seq(0.1, 0.9, by = 0.2), QMC = FALSE,
  seed = 1)
```

Arguments

`params`	named list containing numeric vectors Phi, Rho, Chi, Ksi, M, G and A with the ranges for the input parameters.
`m`	numeric scalar containing the number of Monte Carlo replications (for each correlation intensity). Defaults to `1e5`.
`rho`	a numeric vector containing correlation intensities. Defaults to `seq(0.1,0.9,by=0.2)`.
`QMC`	logical scalar. If `TRUE`, an equidistant grid is generated, if `FALSE`, uniformly distributed random numbers are simulated.
`seed`	numeric scalar containing the random seed for each simulation. Defaults to `1` in order to make results reproducible.

Details

`CorrStudy` performs repeated simulations via `LEgame` with different values for the correlation intensity in order to illustrate the effect of correlation on the deterrent effect of the legal exemption system.

Value

A matrix containing the results of the repeated simulations.

Examples

```
Par <- list(Phi=c(0.1,0.5), Rho=c(0.5,0.9), Ksi=c(0.05,0.3), Chi=c(0.1,0.4),
            M=c(0.2,1.2), G=c(0.05,0.2), A=c(0.1,0.3))
res <- CorrStudy(params=Par, m=10000)
print(res)
```

CorrStudySplit *Investigate the effect of correlated input parameters depending on illegal gain*

Description

CorrStudySplit investigates the effect of correlated input parameters and its dependence on the illegal gain A.

Usage

```
CorrStudySplit(params, m = 1e+05, rho = seq(0.1, 0.9, by = 0.2),
  breaks = seq(0.1, 0.3, by = 0.04), QMC = FALSE, seed = 1)
```

Arguments

params	named list containing numeric vectors Phi, Rho, Chi, Ksi, M, G and A with the ranges for the input parameters.
m	numeric scalar containing the number of Monte Carlo replications (for each correlation intensity). Defaults to 1e5.
rho	a numeric vector containing correlation intensities. Defaults to seq(0.1,0.9,by=0.2).
breaks	a numeric vector with breaks for the construction of the intervals for the illegal gain A. Defaults to seq(0.1,0.3,by=0.04).
QMC	logical scalar. If TRUE, an equidistant grid is generated, if FALSE, uniformly distributed random numbers are simulated.
seed	numeric scalar containing the random seed for each simulation. Defaults to 1 in order to make results reproducible.

Details

CorrStudySplit performs repeated simulations via LEgame with different values for the correlation intensity and reports results for compliance and expected illegal gain for various subsets of simulated illegal gains A in order to further illustrate the effect of correlation on the deterrent effect of the legal exemption system.

Value

A matrix containing the results of the repeated simulations.

Examples

```
Par <- list(Phi=c(0.1,0.5), Rho=c(0.5,0.9), Ksi=c(0.05,0.3), Chi=c(0.1,0.4),
           M=c(0.2,1.2), G=c(0.05,0.2), A=c(0.1,0.3))
res <- CorrStudySplit(params=Par, m=10000)
print(res)
```

LEgame *Simulate the Legal Exemption Game*

Description

LEgame simulates the legal exemption game.

Usage

```
LEgame(params, m = 1e+05, corrMat = diag(7), QMC = FALSE, seed = 1)
```

Arguments

params	named list containing numeric vectors Phi, Rho, Chi, Ksi, M, G and A with the ranges for the input parameters.
m	numeric scalar containing the number of Monte Carlo replications. Defaults to 1e5.
corrMat	matrix containing the correlation matrix for the simulation. Defaults to a 7x7 identity matrix.
QMC	logical scalar. If TRUE, an equidistant grid is generated, if FALSE, uniformly distributed random numbers are simulated.
seed	numeric scalar containing the random seed for the simulation. Defaults to 1 in order to make results reproducible.

Details

LEgame simulates the deterrent effect of the European cartel law based on a game-theoretic model for the legal exemption system.

Value

A dataframe containing the realized output of the simulation.

Examples

```
Par <- list(Phi=c(0.1,0.5), Rho=c(0.5,0.9), Ksi=c(0.05,0.3), Chi=c(0.1,0.4),
            M=c(0.2,1.2), G=c(0.05,0.2), A=c(0.1,0.3))
res <- LEgame(params=Par, m=100000)
print(aggResults(res))
```

NoRglPlot *Visualize results of simulation of legal exemption system*

Description

NoRglPlot visualizes the results of the simulation of the legal exemption system using 3D-projections and corresponding 3D-plots.

Usage

```
NoRglPlot(res, xvar = "rA", yvar = "rM", zvar = "c", xf = 1, yf = 1,
  zf = 1, pch = 16, phi = 20, theta = -30, d = 2)
```

Arguments

res	dataframe containing results of simulation using LEgame.
xvar	character scalar containing variable for the x-axis. Defaults to "rA", the simulated illegal gain.
yvar	character scalar containing variable for the y-axis. Defaults to "rM", the simulated fine.
zvar	character scalar containing variable for the z-axis. Defaults to "c", the complicance level.
xf	numeric scalar containing scaling constant for the x-axis. Defaults to 1.
yf	numeric scalar containing scaling constant for the y-axis. Defaults to 1.
zf	numeric scalar containing scaling constant for the z-axis. Defaults to 1.
pch	numeric or character scalar containing the plot character used for the individual points. Defaults to 16.
phi	numeric scalar containing the phi angle (colatitude) for the perspective in degrees. Defaults to 20.
theta	numeric scalar containing the theta angle (azimuthal direction) for the perspective in degrees. Defaults to -30.
d	numeric scalar for the strenth of the perspective effect. Defaults to 2.

Details

NoRglPlot visualizes the results of the simulation of the legal exemption system using 3D-projections and corresponding plots without using rgl/GL.

Value

Nothing useful, function called for its side effects.

Examples

```
Par <- list(Phi=c(0.1,0.5), Rho=c(0.5,0.9), Ksi=c(0.05,0.3), Chi=c(0.1,0.4),
            M=c(0.2,1.2), G=c(0.05,0.2), A=c(0.1,0.3))
NoRglPlot(LEgame(params=Par, m=10000))
```

SimEUCartelLaw *Simulation of Legal Exemption System for European Cartel Law*

Description

SimEUCartelLaw implements simulation methods for the legal exemption system fot the European cartel law.

Details

SimEUCartelLaw implements Monte Carlo simulations of a game-theoretic model for the legal exemption system of the European cartel in order to estimate the (mean) deterrent effect of this system. The input and output parameters of the simulated cartel opportunities can be visualized by three-dimensional projections.

Examples

```
Par <- list(Phi=c(0.1,0.5), Rho=c(0.5,0.9), Ksi=c(0.05,0.3), Chi=c(0.1,0.4),
            M=c(0.2,1.2), G=c(0.05,0.2), A=c(0.1,0.3))
res <- LEgame(params=Par,m=100000)
print(aggResults(res))
print(CorrStudy(params=Par, m=10000))
print(CorrStudySplit(params=Par, m=10000))

NoRglPlot(LEgame(params=Par, m=10000))
```

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