Package ‘EvolutionaryGames’

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Description

Brown-von Neumann-Nash replicator dynamic as a type of evolutionary dynamics.

Usage

BNN(time, state, parameters)

Arguments

time  
Regular sequence that represents the time sequence under which simulation takes place.

state  
Numeric vector that represents the initial state.

parameters  
Numeric vector that represents parameters needed by the dynamic.

Value

Numeric list. Each component represents the rate of change depending on the dynamic.

Author(s)

Daniel Gebele <dngebele@gmail.com>

References


Examples

dynamic <- BNN
A <- matrix(c(0, -2, 1, 1, 0, -2, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)
phaseDiagram3S(A, dynamic, NULL, state, FALSE, FALSE)
**Description**

Best response dynamic as a type of evolutionary dynamics.

**Usage**

```
BR(time, state, parameters)
```

**Arguments**

- **time**: Regular sequence that represents the time sequence under which simulation takes place.
- **state**: Numeric vector that represents the initial state.
- **parameters**: Numeric vector that represents parameters needed by the dynamic.

**Value**

Numeric list. Each component represents the rate of change depending on the dynamic.

**Author(s)**

Daniel Gebele <dngebele@gmail.com>

**References**


**Examples**

```r
dynamic <- BR
A <- matrix(c(0, -2, 1, 1, 0, -2, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)
phaseDiagram3S(A, dynamic, NULL, state, FALSE, FALSE)
```
**ESS**

*ESS for two-player games with a maximum of three strategies*

**Description**
Computes Evolutionary Stable Strategies of a game with two players and a maximum of three strategies.

**Usage**

```
ESS(A, strategies = c(), floats = TRUE)
```

**Arguments**
- **A**: Numeric matrix of size 2x2 or 3x3 representing the number of strategies of a symmetric matrix game.
- **strategies**: String vector of length n that names all strategies whereas n represents the number of strategies.
- **floats**: Logical value that handles number representation. If set to TRUE, floating-point arithmetic will be used, otherwise fractions. Default is TRUE.

**Value**
Numeric matrix. Each row represents an ESS.

**Author(s)**
Daniel Gebele <dngebele@gmail.com>

**References**

**Examples**

```
ESS(matrix(c(-1, 4, 0, 2), 2, byrow=TRUE), c("Hawk", "Dove"), FALSE)
ESS(matrix(c(1, 2, 0, 1, 2, 0, 1), 3, byrow=TRUE))
```
ESset

Evolutionarily stable set for two-player games with three strategies

Description

Computes evolutionarily stable sets of a game with two players and three strategies.

Usage

ESset(A, strategies = c("1", "2", "3"), floats = TRUE)

Arguments

A Numeric matrix of size 3x3 representing the number of strategies of a symmetric matrix game.

strategies String vector of length 3 that names all strategies.

floats Logical value that handles number representation. If set to TRUE, floating-point arithmetic will be used, otherwise fractions. Default is TRUE.

Value

Numeric matrix. Each row represents the start and end point of a line (ESset). In addition, a plot of the ESset in the game will be created.

Author(s)

Daniel Gebele <dngebele@gmail.com>

References


Examples

# Please note that the computation of evolutionarily stable sets
# is rather time-consuming.
# Depending on your machine you might need to wait more
# than 10 seconds in order to run the following example.
## Not run:
A <- matrix(c(-2, 5, 10/9, 0, 5/2, 10/9, -10/9, 35/9, 10/9), 3, byrow=TRUE)
strategies <- c("Hawk", "Dove", "Mixed ESS")
ESset(A, strategies)

## End(Not run)
ILogit dynamic

Description

Imitative Logit dynamic as a type of evolutionary dynamics.

Usage

ILogit(time, state, parameters)

Arguments

time       Regular sequence that represents the time sequence under which simulation takes place.
state      Numeric vector that represents the initial state.
parameters Numeric vector that represents parameters needed by the dynamic.

Value

Numeric list. Each component represents the rate of change depending on the dynamic.

Author(s)

Jochen Staudacher <jochen.staudacher@hs-kempten.de>

References


Examples

dynamic <- ILogit
A <- matrix(c(-1, 0, 0, -1, 0, 0, -1), 3, byrow=TRUE)
state <- matrix(c(0.1, 0.2, 0.7, 0.2, 0.7, 0.1, 0.9, 0.05, 0.05), 3, byrow=TRUE)
eta <- 0.7
phaseDiagram3S(A, dynamic, eta, state, TRUE, FALSE)
Description

Logit dynamic as a type of evolutionary dynamics.

Usage

Logit(time, state, parameters)

Arguments

time
Regular sequence that represents the time sequence under which simulation takes place.

state
Numeric vector that represents the initial state.

parameters
Numeric vector that represents parameters needed by the dynamic.

Value

Numeric list. Each component represents the rate of change depending on the dynamic.

Author(s)

Daniel Gebele <dngebele@gmail.com>

References


Examples

dynamic <- Logit
A <- matrix(c(0, -2, 1, 1, 0, -2, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)
eta <- 0.1
phaseDiagram3S(A, dynamic, eta, state, FALSE, FALSE)
MSReplicator

Maynard Smith replicator dynamic

Description

Maynard Smith replicator dynamic as a type of evolutionary dynamics.

Usage

MSReplicator(time, state, parameters)

Arguments

- **time**: Regular sequence that represents the time sequence under which simulation takes place.
- **state**: Numeric vector that represents the initial state.
- **parameters**: Numeric vector that represents parameters needed by the dynamic.

Value

Numeric list. Each component represents the rate of change depending on the dynamic.

Author(s)

Daniel Gebele <dngebele@gmail.com>

References


Examples

dynamic <- MSReplicator
A <- matrix(c(0, -2, 1, 1, 0, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)
phaseDiagram3S(A, dynamic, NULL, state, FALSE, FALSE)
Phase Diagram for two-player games with two strategies

Description

Plots phase diagram of a game with two players and two strategies.

Usage

phaseDiagram2S(A, dynamic, params = NULL, vectorField = TRUE, strategies = c("1", "2"))

Arguments

A Numeric matrix of size 2x2 representing the number of strategies of a symmetric matrix game.
dynamic Function representing an evolutionary dynamic.
params Numeric vector representing additional parameters for the evolutionary dynamic.
vectorField Logical value that handles vector field presentation. If set to TRUE, vector field will be shown, otherwise not. Default is TRUE.
strategies String vector of length 2 that names all strategies.

Value

None.

Author(s)

Daniel Gebele <dngebele@gmail.com>

Examples

A <- matrix(c(-1, 4, 0, 2), 2, 2, byrow=TRUE)
phaseDiagram2S(A, Replicator, strategies = c("Hawk", "Dove"))
### Description

Plots phase diagram of a game with two players and three strategies.

### Usage

```r
phasediagram3S(A, dynamic, params = NULL, trajectories = NULL, contour = FALSE, vectorfield = FALSE, strategies = c("1", "2", "3"))
```

### Arguments

- **A**: Numeric matrix of size 3x3 representing the number of strategies of a symmetric matrix game.
- **dynamic**: Function representing an evolutionary dynamic.
- **params**: Numeric vector with additional parameters for the evolutionary dynamic.
- **trajectories**: Numeric matrix of size mx3. Each row represents the initial values for the trajectory to be examined.
- **contour**: Logical value that handles contour diagram presentation. If set to `TRUE`, contour diagram will be shown, otherwise not. Default is `FALSE`.
- **vectorField**: Logical value that handles vector field presentation. If set to `TRUE`, vector field will be shown, otherwise not. Default is `FALSE`.
- **strategies**: String vector of length 3 that names all strategies.

### Value

None.

### Author(s)

Daniel Gebele <dngebele@gmail.com>

### Examples

```r
A <- matrix(c(0, -2, 1, 1, 0, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)

phasediagram3S(A, Replicator, NULL, state, FALSE, FALSE)
phasediagram3S(A, Replicator, NULL, state, TRUE, TRUE)

# Plot two trajectories rather than only one:
A <- matrix(c(0, -2, 1, 1, 0, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.6, 0.2, 0.2), 2, 3, byrow=TRUE)
phasediagram3S(A, Replicator, NULL, state, FALSE, FALSE)
```
**phaseDiagram4S**

**Phase Diagram for two-player games with four strategies**

**Description**

Plots phase diagram of a game with two players and four strategies.

**Usage**

```r
phaseDiagram4S(A, dynamic, params = NULL, trajectory = NULL,
strategies = c("1", "2", "3", "4"), noRGL = TRUE)
```

**Arguments**

- **A**: Numeric matrix of size 4x4 representing the number of strategies of a symmetric matrix game.
- **dynamic**: Function representing an evolutionary dynamic.
- **params**: Numeric vector with additional parameters for the evolutionary dynamic.
- **trajectory**: Numeric vector of size 4 representing the initial value for the trajectory to be examined.
- **strategies**: String vector of length 4 that names all strategies.
- **noRGL**: Logical value that handles diagram rotation. If set to FALSE, diagram will be rotatable, otherwise not. Default is TRUE.

**Value**

None.

**Author(s)**

Daniel Gebele <dngebele@gmail.com>

**Examples**

```r
A <- matrix(c(5, -9, 6, 8, 20, 1, 2, -18, -14, 0, 2, 20, 13, 0, 4, -13),
4, 4, byrow=TRUE)
state <- c(0.3, 0.2, 0.1, 0.4)
phaseDiagram4S(A, Replicator, NULL, state)
```
Replicator dynamic as a type of evolutionary dynamics.

Usage

Replicator(time, state, parameters)

Arguments

time Regular sequence that represents the time sequence under which simulation takes place.

state Numeric vector that represents the initial state.

parameters Numeric vector that represents parameters needed by the dynamic.

Value

Numeric list. Each component represents the rate of change depending on the dynamic.

Author(s)

Daniel Gebele <dngebele@gmail.com>

References


Examples

dynamic <- Replicator
A <- matrix(c(0, -2, 1, 1, 0, -2, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)
phaseDiagram3S(A, dynamic, NULL, state, FALSE, FALSE)
Description

Smith dynamic as a type of evolutionary dynamics.

Usage

Smith(time, state, parameters)

Arguments

time Regular sequence that represents the time sequence under which simulation takes place.

state Numeric vector that represents the initial state.

parameters Numeric vector that represents parameters needed by the dynamic.

Value

Numeric list. Each component represents the rate of change depending on the dynamic.

Author(s)

Daniel Gebele <dngebele@gmail.com>

References


Examples

dynamic <- Smith
A <- matrix(c(0, -2, 1, 1, 0, -2, -2, 1, 0), 3, byrow=TRUE)
state <- matrix(c(0.4, 0.3, 0.3), 1, 3, byrow=TRUE)
phaseDiagram3S(A, dynamic, NULL, state, FALSE, FALSE)
triangle

Triangle for 2-simplex operations

Description
Generates a triangle representing the 2-simplex.

Usage
\[
\text{triangle}(\text{labels} = c("1", "2", "3"))
\]

Arguments
labels String vector of length 3 that names the edges of the triangle.

Value
List of size 2 with members \text{coords} and \text{canvas}. \text{coords} holds edge coordinates of the 2-simplex, \text{canvas} a ggplot2 plot object of the 2-simplex.

Author(s)
Daniel Gebele <dngebele@gmail.com>

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