

# Package ‘FuzzyM’

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**Type** Package

**Title** Fuzzy Cognitive Maps Operations

**Version** 0.1.0

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**Description** Contains functions for operations with fuzzy cognitive maps using t-norm and s-norm operators. T-norms and S-norms are described by Dov M. Gabbay and George Metcalfe (2007) <doi:10.1007/s00153-007-0047-1>. System indicators are described by Cox, Earl D. (1995) <isbn:1886801010>. Executable examples are provided in the ``inst/examples" folder.

**License** MIT + file LICENSE

**Encoding** UTF-8

**RoxygenNote** 7.1.2

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**Config/testthat/edition** 3

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maxtix_tranz	<i>matrix_tranz</i>
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**Description**

The maxtix\_tranz set of functions is aimed to calculate dissonance, consonance and influence

**Usage**

```
tnorm_functions
snorm_functions
snorm_functions_reverse
tnorm_functions_reverse
positive_matrix_calc(initmatrix)

transitive_closure(
  positivematrix,
  tnorm,
  snorm,
  snormMatrix,
  gammaTnormMean,
  algaTnorm,
  gammaTnorm,
  piTnorm,
  gammaSnorm,
  piSnorm
)

matrix_transitive_join(matrix, snorm, gammaSnorm, piSnorm)

consonanse_dissonanse(finalmatrix)

cross_consonanse(finalmatrix)

cross_dissonanse(finalmatrix)

cross_positive_influence(finalmatrix)

cross_negative_influence(finalmatrix)

impuls_vector(vector, matrix)

multiply_vector(matrix, vector)
```

```
multiply_matrix(  
  matrix_1,  
  matrix_2,  
  tnorm,  
  snorm,  
  gammaTnormMean,  
  algaTnorm,  
  gammaTnorm,  
  piTnorm,  
  gammaSnorm,  
  piSnorm  
)  
  
maximum_matrix(matrix_1, matrix_2)  
  
ik_pos_maximum(matrix, initMatrix, ipath, jpath)  
  
ik_neg_maximum(matrix, initMatrix, ipath, jpath)  
  
reverse_task(  
  df_matrix,  
  vectorY,  
  tnorm,  
  tnorm_reverse,  
  snorm,  
  snormMatrix,  
  snorm_reverse  
)  
  
direct_task(df_matrix, vectorX, tnorm, snorm, snormMatrix)
```

### Arguments

initmatrix	matrix
positivematrix	matrix
tnorm	function
snorm	function
snormMatrix	function
gammaTnormMean	function
algaTnorm	function
gammaTnorm	function
piTnorm	function
gammaSnorm	function
piSnorm	function
matrix	matrix

finalmatrix	matrix
vector	matrix
matrix_1	matrix
matrix_2	matrix
initMatrix	matrix
ipath	vector
jpath	vector
df_matrix	matrix
vectorY	vector
tnorm_reverse	function
snorm_reverse	function
vectorX	vector

### Value

eigen values of initmatrix

positive matrix of initmatrix

transitive closure of positivematrix

aggregation function for transitive closure of matrix

system indicators of finalmatrix

cross consonance of finalmatrix

cross dissonance of finalmatrix

cross positive influence of finalmatrix

cross negative influence of finalmatrix

impulse of matrix based on vector

multiplication of matrix and vector

multiplication of matrix\_1 and matrix\_2

maximum of matrix\_1 and matrix\_2

ik walk for matrix based on initMatrix with ipath and jpath

ik negative walk for matrix based on initMatrix with ipath and jpath

reverse task solution for df\_matrix with vectorY using tnorm, tnorm\_reverse, snorm, snormMatrix, snorm\_reverse

direct task solution for df\_matrix with vectorX using tnorm, snorm, snormMatrix

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 maxtix\_tranz\_probability

*FCM package with functions for matrix probability calculations*


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### Description

The maxtix\_tranz\_probability set of functions is aimed to calculate maximum matrix based on transitive closure

### Usage

```
multiply_matrix_prob(matrix_1, matrix_2)

transitive_closure_prob(positivematrix)

transitive_closure_prob_max(positivematrix)

probability_matrix_transitive(maxmatrix)
```

### Arguments

matrix_1	matrix
matrix_2	matrix
positivematrix	matrix
maxmatrix	matrix

### Value

multiplication of matrix matrix\_1 and matrix\_2  
 transitive closure of matrix positivematrix  
 transitive closure of matrix positivematrix with max function  
 joined transitive closure of matrix maxmatrix

---

 polinomial\_eq\_dominant

*FCM package with functions for matrix manipulations*


---

### Description

polinomial\_eq\_dominant set contains 1 function: reverse task calculation. Each function takes a matrix, vector and t-norm as arguments and returns a solution matrix. The calculation procedure of the function includes a solution existence check and a solution check.

**Usage**

```
calc_reverse_task(matrix, vector, tnorm, tnorm_reverse, snorm, snorm_reverse)
```

**Arguments**

matrix	matrix
vector	vector
tnorm	function
tnorm_reverse	function
snorm	function
snorm_reverse	function

**Value**

solution of polynomial equation of matrix matrix, vector using tnorm, tnorm\_reverse, snorm, snorm\_reverse

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s_norm	<i>s_norm</i>
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**Description**

s\_norm set of functions is aimed to calculate drastic, einstein, algebraic, hamacher products, min and bounded difference S-norms

**Usage**

```
drastic_sum_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
bounded_sum_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
einstein_sum_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
algebraic_sum_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
hamacher_sum_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
max_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
hamacher_union_operator_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
yager_union_operator_snorm(element1, element2, gammaSnorm, piSnorm)
```

```
snorm_functions
```

```
get_snorm(typeSnorm)
```

**Arguments**

element1, element2  
                                   paramater  
 gammaSnorm, piSnorm, typeSnorm  
                                   norm

**Format**

An object of class list of length 8.

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s_norm_reverse	<i>FCM package with functions for reverse S-norms calculations</i>
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**Description**

s\_norm\_reverse set of functions is aimed to calculate drastic, einstein, algebraic, hamacher products, min and bounded difference reverse S-norms

**Usage**

```

drastic_sum_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
bounded_sum_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
einstein_sum_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
algebraic_sum_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
hamacher_sum_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
max_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
hamacher_union_operator_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
yager_union_operator_snorm_reverse(element1, element2, gammaSnorm, piSnorm)
snorm_functions_reverse
get_snorm_reverse(typeSnorm)
  
```

**Arguments**

element1, element2  
                                   paramater  
 gammaSnorm, piSnorm, typeSnorm  
                                   norm

**Format**

An object of class list of length 8.

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<i>t_norm</i>	<i>t_norm</i>
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**Description**

*t\_norm* set of functions is aimed to calculate drastic, einstein, algebraic, hamacher products, min and bounded difference T-norms

**Usage**

```
min_tnorm(element1, element2, gammaTnormMean, algaTnorm, gammaTnorm, piTnorm)
```

```
hamacher_product_tnorm(
  element1,
  element2,
  gammaTnormMean,
  algaTnorm,
  gammaTnorm,
  piTnorm
)
```

```
algebraic_product_tnorm(
  element1,
  element2,
  gammaTnormMean,
  algaTnorm,
  gammaTnorm,
  piTnorm
)
```

```
einstein_product_tnorm(
  element1,
  element2,
  gammaTnormMean,
  algaTnorm,
  gammaTnorm,
  piTnorm
)
```

```
bounded_difference_tnorm(
  element1,
  element2,
  gammaTnormMean,
  algaTnorm,
```



```
    gammaTnorm,  
    piTnorm  
  )  
  
  drastic_product_tnorm(  
    element1,  
    element2,  
    gammaTnormMean,  
    algaTnorm,  
    gammaTnorm,  
    piTnorm  
  )  
  
  parameterized_mean_intersection_operator_tnorm(  
    element1,  
    element2,  
    gammaTnormMean,  
    algaTnorm,  
    gammaTnorm,  
    piTnorm  
  )  
  
  dubois_intersection_operator_tnorm(  
    element1,  
    element2,  
    gammaTnormMean,  
    algaTnorm,  
    gammaTnorm,  
    piTnorm  
  )  
  
  hamacher_intersection_operator_tnorm(  
    element1,  
    element2,  
    gammaTnormMean,  
    algaTnorm,  
    gammaTnorm,  
    piTnorm  
  )  
  
  yager_intersection_operator_tnorm(  
    element1,  
    element2,  
    gammaTnormMean,  
    algaTnorm,  
    gammaTnorm,  
    piTnorm  
  )
```

```
tnorm_functions
get_tnorm(typeTnorm)
```

### Arguments

```
element1, element2
                paramater
gammaTnormMean, algaTnorm, gammaTnorm, piTnorm, typeTnorm
                norm
```

### Format

An object of class list of length 10.

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<i>t_norm_reverse</i>	<i>t_norm_reverse</i>
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---

### Description

*t\_norm\_reverse* set of functions is aimed to calculate drastic, einstein, algebraic, hamacher products, min and bounded difference reverse T-norms

### Usage

```
min_tnorm_reverse(
  element1,
  element2,
  gammaTnormMean,
  algaTnorm,
  gammaTnorm,
  piTnorm
)

hamacher_product_tnorm_reverse(
  element1,
  element2,
  gammaTnormMean,
  algaTnorm,
  gammaTnorm,
  piTnorm
)

algebraic_product_tnorm_reverse(
  element1,
  element2,
```

```
    gammaTnormMean,  
    algaTnorm,  
    gammaTnorm,  
    piTnorm  
  )  
  
einstein_product_tnorm_reverse(  
  element1,  
  element2,  
  gammaTnormMean,  
  algaTnorm,  
  gammaTnorm,  
  piTnorm  
)  
  
bounded_difference_tnorm_reverse(  
  element1,  
  element2,  
  gammaTnormMean,  
  algaTnorm,  
  gammaTnorm,  
  piTnorm  
)  
  
drastic_product_tnorm_reverse(  
  element1,  
  element2,  
  gammaTnormMean,  
  algaTnorm,  
  gammaTnorm,  
  piTnorm  
)  
  
parameterized_mean_intersection_operator_tnorm_reverse(  
  element1,  
  element2,  
  gammaTnormMean,  
  algaTnorm,  
  gammaTnorm,  
  piTnorm  
)  
  
dubois_intersection_operator_tnorm_reverse(  
  element1,  
  element2,  
  gammaTnormMean,  
  algaTnorm,  
  gammaTnorm,
```

```
    piTnorm
  )

  hamacher_intersection_operator_tnorm_reverse(
    element1,
    element2,
    gammaTnormMean,
    algaTnorm,
    gammaTnorm,
    piTnorm
  )

  yager_intersection_operator_tnorm_reverse(
    element1,
    element2,
    gammaTnormMean,
    algaTnorm,
    gammaTnorm,
    piTnorm
  )

  tnorm_functions_reverse

  get_tnorm_reverse(typeTnorm)
```

**Arguments**

```
  element1, element2
                paramater
  gammaTnormMean, algaTnorm, gammaTnorm, piTnorm, typeTnorm
                norm
```

**Format**

An object of class list of length 10.

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