

# Package ‘goalprog’

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**Depends** R (>= 2.0.1), lpSolve

**Description** A collection of functions to solve weighted and lexicographical goal programming problems as specified by Lee (1972) and Ignizio (1976).

**Title** Weighted and lexicographical goal programming and optimization

**License** GPL (>= 2)

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achievements	<i>Ignizio (1976) Example Data Sets</i>
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**Description**

The data set is a data frame that defines the achievement goals  $g_1(n, p), g_2(n, p), \dots, g_K(n, p)$ . The columns depend on the formulation of the goal programming problem.

For a lexicographical goal programming problem, the data frame has four named columns. The first column is called 'objective' and it contains the index for a particular problem object. The second column is called 'priority' and it is the level to which the row (i.e. objective) is assigned. The third column is called 'p' and it contains the weight associated with the positive deviation variable. The fourth column is called 'n' and it contains the weight associated with the negative deviation variable. An objective can appear in two rows if each deviation variable is to be assigned to a different priority level.

For a weighted goal programming problem, the data frame has five named columns. The first four columns are identical to the columns in the data frame for a lexicographical goal programming problem. The fifth column is called 'w' and it is the weight associated with the specified priority level.

**Format**

The data set is a data frame.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

**See Also**

[ignizio.datasets](#)

---

calc.ta

*Calculate achievement function for the k-th priority level*

---

**Description**

This function calculates the achievement function for the k-th priority level.

**Usage**

```
calc.ta(tab, k)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
k	an integer priority level

**Value**

None.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

`calc.ta.k`*Calculate the achievement for the highest k priority levels*

---

**Description**

This function calculates the achievement function for priority levels 1 through k.

**Usage**

```
calc.ta.k(tab, k)
```

**Arguments**

<code>tab</code>	An object of class 'llgptab' that is the modified simplex tableau
<code>k</code>	An integer priority level

**Value**

An object of class 'llgptab' in which the index rows have been updated.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[calc.ta](#), [llgptab](#)

---

`calc.ti`*Calculate the k-th index row*

---

**Description**

This function calculates the index row for the k-th priority level.

**Usage**

```
calc.ti(tab, k)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
k	An integer priority level

**Value**

None.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

calc.ti.k

*Calculate index rows for levels 1 through k*

---

**Description**

This function calculates the index rows for the highest k priority levels

**Usage**

```
calc.ti.k(tab, k)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
k	An integer priority level

**Value**

An object of class 'llgptab' in which the index rows have been updated.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

## References

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

## See Also

[calc.ti](#), [llgptab](#)

---

check.ev.cp

*Check entering variable for complementary pivoting*

---

## Description

This function determines if the candidate non-basic variable can enter the solution basis based on complementary pivoting.

## Usage

```
check.ev.cp(tab, s)
```

## Arguments

tab	A list of named components that are the augmented modified simplex tableau
s	An integer index for the candidate non-basic variable

## Details

This test only applies to decision variables and not to the deviation variables. It determines if there is a basic decision variable in the current solution that is in the same complementary class as the candidate decision variable. If there is, then the function returns FALSE to indicate that the candidate variable cannot be added. Otherwise, the function returns true.

## Value

A boolean value TRUE or FALSE.

## Author(s)

Frederick Novomestky <fnovomes@poly.edu>

---

check.tb	<i>Check for negative RHS values and repair tableau</i>
----------	---

---

**Description**

This function examines the b vector (i.e. target values). If any negative values are found, then the elements matrix is repaired and appropriate labels and vectors are exchanged.

**Usage**

```
check.tb(tab)
```

**Arguments**

tab                    An object of class 'llgptab' that is the modified simplex tableau

**Value**

An object of class 'llgptab' in which the index rows have been updated.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

coefficients	<i>Ignizio (1976) Example Data Sets</i>
--------------	---

---

**Description**

The data set is a matrix of coefficients for the linear objective functions for a linear goal programming problem. The number of rows equals the number of objectives and the number columns equals the number of decision variables.

**Format**

The data set is a matrix.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

**See Also**

[ignizio.datasets](#)

---

 dv.llgp

*Determine subscript of departing variable for a LLGP problem*

---

**Description**

Determine subscript of departing variable for a lexicographical linear goal programming (LLGP) problem.

**Usage**

dv.llgp(tab, sp)

**Arguments**

tab	An object of class 'llgptab' the modified simplex tableau
sp	An integer index of non-basic variable to enter the basis

**Details**

Determine the row associated with the minimum  $b_i/e_{ij}$ . In the event of a tie, select the row having the basic variable with the higher priority level. Designate this row as  $i'$ . The basic variable associated with row  $i'$  is the departing variable.

**Value**

An integer index for the variable departing the basis.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#), [dv.tie](#)

---

dv.tie

*Resolve tie for departing variables*

---

**Description**

This function returns the row index of the departing variable based on which of the corresponding variables has a higher priority level.

**Usage**

```
dv.tie(tab, i, ip)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
i	An integer index for a departing variable
ip	An integer index for a departing variable

**Value**

An integer index for a departing variable.

**Author(s)**

Frederick Novomestky <[fnovomes@poly.edu](mailto:fnovomes@poly.edu)>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[dv.llgp](#), [llgptab](#)

---

`ev.llgp`*Determine subscript of entering variable*

---

**Description**

This function returns the subscript of the non-basic variable entering the basis at the k-th priority level.

**Usage**

```
ev.llgp(tab, k)
```

**Arguments**

<code>tab</code>	An object of class 'llgptab' the modified simplex tableau
<code>k</code>	An integer priority level

**Value**

An integer value.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#), [dv.llgp](#)

---

`fix.fp`*Round floating point values that are with tolerance of integer*

---

**Description**

This function returns a numeric value that is integer if it is within the specified tolerance of being integer. Otherwise, the given argument value is returned.

**Usage**

```
fix.fp(z, tol = 1e-04)
```

**Arguments**

- z                    A numeric floating or integer value
- tol                The tolerance used to determine how close argument z is an integer

**Value**

A numeric value.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

**Examples**

```
fix.fp( 1.01 )  
fix.fp( 1.001 )  
fix.fp( 1.0001 )  
fix.fp( 1.00001 )  
fix.fp( 1.000001 )
```

---

`get.variable.class`      *Get the variable complementarity class*

---

**Description**

This function returns an integer complementarity class for the given variable name.

**Usage**

```
get.variable.class(tab, variable)
```

**Arguments**

- tab                A list of named components with the augmented modified simplex tableau
- variable        A character string with the name of the variable

**Details**

The function uses the `variable.classes` component of the `tableau` to determine the complementarity class for the given variable. If the variable is not found then a zero value is returned.

**Value**

A positive integer if the variable is found; zero otherwise.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**See Also**

[check.ev.cp](#)

---

ignizio.datasets

*Ignizio (1976) Sample Data Sets*

---

**Description**

A collection and description of data sets that are examples found in Ignizio (1976). These are examples of goal programming problems solved using the methods described by Ignizio.

**Format**

Each data set is an R file that creates the coefficients matrix, the vector of target values and the data frame of achievement goals.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

**See Also**

[ignizio.example.3.1](#), [ignizio.example.3.2](#), [ignizio.example.3.3](#), [ignizio.example.3.5](#), [ignizio.example.3.6](#), [llgp](#)

---

ignizio.example.3.1    *Ignizio (1976) Example Data Sets*

---

### Description

The data set that corresponds to Example 3-1 found in Ignizio (1976). These are examples of goal programming problems solved using the methods described by author.

Find  $\mathbf{x}' = [x_1, x_2]$ ,  $\mathbf{n}' = [n_1, n_2, n_3]$  and  $\mathbf{p}' = [p_1, p_2, p_3]$  that minimize  $\mathbf{a} = [(2p_1), (n_2), (n_3)]$

The objectives are as follows

$$10x_1 + 15x_2 + n_1 - p_1 = 40$$

$$100x_1 + 100x_2 + n_2 - p_2 = 1000$$

$$x_2 + n_3 - p_3 = 7$$

$\mathbf{x}, \mathbf{n}, \mathbf{p} \geq \mathbf{0}$

The solution is  $\mathbf{x}' = [4, 0]$  and  $\mathbf{a} = [0, 600, 7]$

### Format

The data set is an R file that creates the coefficients matrix, the vector of target values and the data frame of achievement goals.

### Author(s)

Frederick Novomestky <fnovomes@poly.edu>

### References

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

### See Also

[ignizio.datasets](#)

### Examples

```
data( ignizio.example.3.1 )
soln <- llgp( coefficients, targets, achievements )
```

---

**ignizio.example.3.2** *Ignizio (1976) Example Data Sets*

---

**Description**

The data set that corresponds to Example 3-2 found in Ignizio (1976). These are examples of goal programming problems solved using the methods described by author.

Find  $\mathbf{x}' = [x_1, x_2]$ ,  $\mathbf{n}' = [n_1, n_2, n_3, n_4]$  and  $\mathbf{p}' = [p_1, p_2, p_3, p_4]$  that minimize  $\mathbf{a} = [(2p_1), (n_2), (n_3)]$

The objectives are as follows

$$x_1 + x_2 + n_1 - p_1 = 40$$

$$x_1 + x_2 + n_2 - p_2 = 100$$

$$x_1 + n_3 - p_3 = 30$$

$$x_2 + n_4 - p_4 = 15$$

$$\mathbf{x}, \mathbf{n}, \mathbf{p} \geq \mathbf{0}$$

The solution is  $\mathbf{x}' = [4, 0]$  and  $\mathbf{a} = [25, 0, 60, 5]$

**Format**

The data set is an R file that creates the coefficients matrix, the vector of target values and the data frame of achievement goals.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

**See Also**

[ignizio.datasets](#)

**Examples**

```
data( ignizio.example.3.2 )
soln <- llgp( coefficients, targets, achievements )
```

---

ignizio.example.3.3    *Ignizio (1976) Example Data Sets*

---

### Description

The data set that corresponds to Example 3.3 found in Ignizio (1976). These are examples of goal programming problems solved using the methods described by author.

Find  $\mathbf{x}' = [x_1, x_2]$ ,  $\mathbf{n}' = [n_1, n_2, n_3, n_4]$  and  $\mathbf{p}' = [p_1, p_2, p_3, p_4]$  that minimize  $\mathbf{a} = [(2p_1 + 3p_2), (n_3), (p_4)]$

The objectives are as follows

$$x_1 + x_2 + n_1 - p_1 = 10$$

$$x_1 + n_2 - p_2 = 4$$

$$5x_1 + 3x_2 + n_3 - p_3 = 56$$

$$x_1 + x_2 + n_4 - p_4 = 12$$

$$\mathbf{x}, \mathbf{n}, \mathbf{p} \geq \mathbf{0}$$

The solution is  $\mathbf{x}' = [4, 6]$  and  $\mathbf{a} = [0, 18, 0]$

### Format

The data set is an R file that creates the coefficients matrix, the vector of target values and the data frame of achievement goals.

### Author(s)

Frederick Novomestky <fnovomes@poly.edu>

### References

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

### See Also

[ignizio.datasets](#)

### Examples

```
data( ignizio.example.3.3 )
soln <- llgp( coefficients, targets, achievements )
```

---

ignizio.example.3.5    *Ignizio (1976) Example Data Sets*

---

### Description

The data set that corresponds to Example 3-5 found in Ignizio (1976). These are examples of goal programming problems solved using the methods described by author.

Find  $\mathbf{x}' = [x_1, x_2]$ ,  $\mathbf{n}' = [n_1, n_2, n_3, n_4]$  and  $\mathbf{p}' = [p_1, p_2, p_3, p_4]$  that minimize  $\mathbf{a} = [(2p_1), (n_2), (n_3)]$

The objectives are as follows

$$8x_1 + 12x_2 + n_1 - p_1 = 10000$$

$$x_1 + 2x_2 + n_2 - p_2 = 40$$

$$x_1 + n_3 - p_3 = 30$$

$$x_2 + n_4 - p_4 = 15$$

$$\mathbf{x}, \mathbf{n}, \mathbf{p} \geq \mathbf{0}$$

The solution is  $\mathbf{x}' = [30, 15]$  and  $\mathbf{a} = [0, 580, 20, 0]$

### Format

The data set is an R file that creates the coefficients matrix, the vector of target values and the data frame of achievement goals.

### Author(s)

Frederick Novomestky <fnovomes@poly.edu>

### References

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

### See Also

[ignizio.datasets](#)

### Examples

```
data( ignizio.example.3.5 )
soln <- llgp( coefficients, targets, achievements )
```

---

ignizio.example.3.6    *Ignizio (1976) Example Data Sets*

---

### Description

The data set that corresponds to Example 3-6 found in Ignizio (1976). These are examples of goal programming problems solved using the methods described by author.

Find  $\mathbf{x}' = [x_1, x_2, x_3, x_4]$ ,  $\mathbf{n}' = [n_1, n_2, n_3, n_4, n_5, n_6, n_7]$  and  $\mathbf{p}' = [p_1, p_2, p_3, p_4, p_5, p_6, p_7]$  that minimize  $\mathbf{a} = [(2p_1), (n_2), (n_3)]$

The objectives are as follows

$$x_1 + x_2 + n_1 - p_1 = 50000$$

$$x_1 + n_2 - p_2 = 20000$$

$$x_2 + n_3 - p_3 = 5000$$

$$x_2 + n_4 - p_4 = 15000$$

$$x_3 + n_5 - p_5 = 10000$$

$$x_4 + n_6 - p_6 = 30000$$

$$0.06x_1 + 0.05x_2 + 0.08x_3 + 0.07x_4 + n_7 - p_7 = 4000$$

$$\mathbf{x}, \mathbf{n}, \mathbf{p} \geq \mathbf{0}$$

The solution is  $\mathbf{x}' = [20000, 5000, 0, 25000]$  and  $\mathbf{a} = [0, 0, 5000, 10800]$

### Format

The data set is an R file that creates the coefficients matrix, the vector of target values and the data frame of achievement goals.

### Author(s)

Frederick Novomestky <fnovomes@poly.edu>

### References

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

### See Also

[ignizio.datasets](#)

### Examples

```
data( ignizio.example.3.6 )
soln <- llgp( coefficients, targets, achievements )
```

llgp

*Solve an LLGP problem***Description**

Solve a lexicographical linear goal programming (LLGP) problem using a modified primal simplex algorithm.

**Usage**

```
llgp(coefficients, targets, achievements, maxiter = 1000, verbose = FALSE)
```

**Arguments**

coefficients	A matrix of coefficients for the linear objective functions
targets	A vector of target values for the objective functions
achievements	A data frame with the deviation variables for each objective together with the priority level
maxiter	The maximum number of iterations with a default value of 1000
verbose	A logical value that determines if intermediate tableaus are to be printed

**Details**

The function implements the Ignizio (1976) modified simplex algorithm. When the user selects verbose=TRUE, the modified simplex tableau is printed at each iteration.

**Value**

An object of class 'llgp' which is a list with three named components

tab	An object of type 'llgptab' for the modified simplex tableau
solution	An object of type 'llgpout' for the optimal solution
converged	A logical value that determines if the algorithm converged to the optimal solution

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[check.tb](#), [calc.ti.k](#), [calc.ta.k](#), [ev.llgp](#), [dv.llgp](#), [piv.llgp](#), [llgptab](#), [llgpout](#)

**Examples**

```
data( ignizio.example.3.3 )
soln <- llgp( coefficients, targets, achievements )
```

---

llgpcp

*Solve an LLGP problem with complementary pivoting*


---

**Description**

Solve a lexicographical linear goal programming (LLGP) problem using a modified primal simplex algorithm with complementary pivoting of the decision variables.

**Usage**

```
llgpcp(coefficients, targets, achievements, variable.classes, maxiter = 1000, verbose = FALSE)
```

**Arguments**

coefficients	A matrix of coefficients for the linear objective functions
targets	A vector of target values for the objective functions
achievements	A data frame with the deviation variables for each objective together with the priority level
variable.classes	A data frame with the complementary class assignments for the decision variables
maxiter	The maximum number of iterations with a default value of 1000
verbose	A logical value that determines if intermediate tableaus are to be printed

**Details**

The function implements the Ignizio (1976) modified simplex algorithm. When the user selects verbose=TRUE, the modified simplex tableau is printed at each iteration.

**Value**

An object of class 'llgpcp' which is a list with three named components

tab	An object of type 'llgpcptab' for the augmented modified simplex tableau
solution	An object of type 'llgpout' for the optimal solution
converged	A logical value that determines if the algorithm converged to the optimal solution

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[check.tb](#), [check.ev.cp](#), [calc.ti.k](#), [calc.ta.k](#), [ev.llgp](#), [dv.llgp](#), [piv.llgp](#), [llgpcptab](#), [llgpout](#)

---

llgpcptab

---

*Create lexicographical LGP tableau*


---

**Description**

This function returns the initial modified simplex tableau as an object of type 'llgpcptab' for a lexicographical linear programming problem with complementary pivoting and for the given objectives and achievement goals

**Usage**

```
llgpcptab(coefficients, targets, achievements, variable.classes)
```

**Arguments**

coefficients	A matrix with the coefficients of the linear objective functions
targets	A vector of target values for the objective functions
achievements	A data frame with the weights of the deviation variables for each objective along with the corresponding priority level
variable.classes	A data frame that defines the complementarity classes for each of the variables

**Details**

The modified simplex tableau contains a top stub matrix, a left stub matrix, an elements matrix, index rows and achievement vector as specified in Ignizio (1976). The tableau is augmented with the variable classes frame.

**Value**

An object of class 'llgpcptab' which is a list with the following named components

iter	Current iteration number initially set to zero
variables	Number of decision variables
levels	Number of priority levels in the achievement function
objectives	Number of objective functions
nonbasics	Number of non basic variables = variables + objectives

level	Current priority level
te	Elements matrix
tb	Vector b initially the target values
tw	Top stub matrix
tu	Left stub matrix
ti	Matrix of index rows
ta	Achievement vector
row.headings	Vector of row headings initially the negative deviation variables
col.headings	Vector of column headings initially the decision and positive deviation variables
variable.classes	Data frame with the complementary classes of the decision variables

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**Examples**

```
data( ignizio.example.3.3 )
tab <- llgptab( coefficients, targets, achievements )
```

---

llgpout

---

*Obtain solution to the LLGP problem*


---

**Description**

This function returns the optimal decision variables, negative deviation variables, positive deviation variables, objective function values, objective target values and the achievement function values.

**Usage**

```
llgpout(tab, coefficients, targets)
```

**Arguments**

tab	a list of named components that specifies the modified simplex tableau
coefficients	a matrix with the coefficients of the linear objective functions
targets	A vector of target values for the objective functions

**Value**

An object of class 'llgpout' that is a list with five named components

x	A numeric vector with the values of the decision variables
n	A numeric vector with the values of the negative deviation variables
p	A numeric vector with the values of the positive deviation variables
f	A numeric vector with the values of the linear objective functions
a	A numeric vector with the values of the achievement functions

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

**Examples**

```
data( ignizio.example.3.3 )
soln <- llgp( coefficients, targets, achievements )
out <- llgpout( soln$tab, coefficients, targets )
```

---

llgptab

---

*Create lexicographical LGP tableau*


---

**Description**

This function returns the initial modified simplex tableau as an object of type 'llgptab' for a lexicographical linear programming problem for the given objectives and achievement goals

**Usage**

```
llgptab(coefficients, targets, achievements)
```

**Arguments**

coefficients	A matrix with the coefficients of the linear objective functions
targets	A vector of target values for the objective functions
achievements	A data frame with the weights of the deviation variables for each objective along with the corresponding priority level

**Details**

The modified simplex tableau contains a top stub matrix, a left stub matrix, an elements matrix, index rows and achievement vector as specified in Ignizio (1976).

**Value**

An object of class 'llgptab' which is a list with the following named components

iter	Current iteration number initially set to zero
variables	Number of decision variables
levels	Number of priority levels in the achievement function
objectives	Number of objective functions
nonbasics	Number of non basic variables = variables + objectives
level	Current priority level
te	Elements matrix
tb	Vector b initially the target values
tw	Top stub matrix
tu	Left stub matrix
ti	Matrix of index rows
ta	Achievement vector
row.headings	Vector of row headings initially the negative deviation variables
col.headings	Vector of column headings initially the decision and positive deviation variables

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**Examples**

```
data( ignizio.example.3.3 )
tab <- llgptab( coefficients, targets, achievements )
```

---

neg.ind.rows	<i>Count number of negative index values</i>
--------------	--

---

**Description**

This function returns a count of the number of negative index values (i.e. rows) above I[k,s].

**Usage**

```
neg.ind.rows(tab, k, s)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
k	An integer priority level
s	An integer index for a non-basic variable

**Value**

An integer value.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

piv.llgp	<i>Modified simplex pivot to change basis variables</i>
----------	---

---

**Description**

This function updates the elements matrix and vector to reflect the change in basis variable.

**Usage**

```
piv.llgp(tab, nevc, ndvr, verbose)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
nevc	The integer column index of the entering variable
ndvr	The integer row index of the departing variable
verbose	A logical value which if true prints the basis change

**Value**

An object of class 'llgptab' that is the updated modified simplext tableau.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

pos.ind.rows	<i>Count number of positive index values above I(k,s)</i>
--------------	---

---

**Description**

This function returns the number of positive index values (i.e. rows) above I(k,s)

**Usage**

```
pos.ind.rows(tab, k, s)
```

**Arguments**

tab	A object of class 'llgptab' that is the modified simplex tableau
k	An integer priority level
s	An integer index for a non-basic variable

**Value**

An integer value.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

<code>print.llgpcptab</code>	<i>Print the LLGP tableau at the current priority level and iteration</i>
------------------------------	---

---

**Description**

This function implements the print generic function for an object of class 'llgpcptab' and does a pretty print of the object of the lexicographical linear goal programming (LLGP) problem with complementary pivoting.

**Usage**

```
print.llgpcptab(x, ...)
```

**Arguments**

<code>x</code>	An object of class 'llgpcptab' which is the modified simplex tableau
<code>...</code>	Other arguments as they may apply to the generic S3 print function

**Details**

The function prints the various stubs in the row and column orders described in Ignizio (1976).

**Value**

No value but a report is printed.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[dv.llgp](#), [llgptab](#)

**Examples**

```
data( ignizio.example.3.3 )
tab <- llgptab( coefficients, targets, achievements )
tab
print( tab )
```

---

print.llgpout	<i>Print the solution</i>
---------------	---------------------------

---

**Description**

This function prints the current solution to a lexicographical linear goal programming (LLGP) problem.

**Usage**

```
print.llgpout(x, ...)
```

**Arguments**

x	An object of class 'llgpout' that contains the current solution
...	Other arguments as can be applied to the S3 generic print function

**Value**

No value is returned but a report showing the decision variables, the goals or objectives and the achievement function.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgpout](#)

**Examples**

```
data( ignizio.example.3.3 )
soln <- llgp( coefficients, targets, achievements )
soln$out
print( soln$out)
```

---

print.llgptab	<i>Print the LLGP tableau at the current priority level and iteration</i>
---------------	---

---

**Description**

This function implements the print generic function for an object of class 'llgptab' and does a pretty print of the object of the lexicographical linear goal programming (LLGP) problem.

**Usage**

```
print.llgptab(x, ...)
```

**Arguments**

x	An object of class 'llgptab' which is the modified simplex tableau
...	Other arguments as they may apply to the generic S3 print function

**Details**

The function prints the various stubs in the row and column orders described in Ignizio (1976).

**Value**

No value but a report is printed.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[dv.llgp](#), [llgptab](#)

**Examples**

```
data( ignizio.example.3.3 )
tab <- llgptab( coefficients, targets, achievements )
tab
print( tab )
```

---

swp.headings	<i>Swap row and column headings</i>
--------------	-------------------------------------

---

**Description**

This function swaps row and column headings to reflect changes in the basis.

**Usage**

```
swp.headings(tab, nr, nc)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
nr	An integer row index
nc	An integer column index

**Value**

An object of class 'llgptab' in which the index rows have been updated.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

swp.vec	<i>Swap row and column vectors</i>
---------	------------------------------------

---

**Description**

This function swaps row and column vectors in the top and left stub matrices.

**Usage**

```
swp.vec(tab, nr, nc)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
nr	An integer row subscript in the left stub matrix
nc	An integer column subscript in the top stub matrix

**Value**

None.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

---

targets

*Ignizio (1976) Example Data Sets*

---

**Description**

The data set is a vector of target values for the objectives. The number of elements is equal to the number of objectives.

**Format**

The data set is a vector.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books.

**See Also**

[ignizio.datasets](#)

---

zero.ind.rows	<i>Count zero index values in column s</i>
---------------	--

---

**Description**

This function returns a count of the number of zero index values in column *s* of index rows *I*.

**Usage**

```
zero.ind.rows(tab, s)
```

**Arguments**

tab	An object of class 'llgptab' that is the modified simplex tableau
s	An integer index value for a non-basic variable

**Value**

An integer value for the number of zero index values in the given column.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Ignizio, J. P. (1976). Goal Programming and Extensions, Lexington Books, D. C. Heath and Company.

**See Also**

[llgptab](#)

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