Package ‘DIconvex’

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Type Package

Title Finding Patterns of Monotonicity and Convexity in Data

Version 1.0.0

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Description Given an initial set of points, this package minimizes the number of elements to discard from this set such that there exists at least one monotonic and convex mapping within pre-specified upper and lower bounds.

Depends lpSolveAPI

License GPL-2

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R topics documented:

`DIconvex` *Finding patterns of monotonicity and convexity in two-dimensional data*

Description

This package takes as input x values $x_1, \ldots, x_n$, as well as lower $L_1, \ldots, L_n$, and upper bounds $U_1, \ldots, U_n$. It maximizes $\sum_{i=1}^{n} f_i,\ f_i \in \{0, 1\}$ such that there exists at least one convex increasing (decreasing) set of values $L_j \leq y_j \leq U_j, j \in C$, where C is the set of indices $i = 1, \ldots, n$ for which $f_i = 1$.

Usage

```
DIconvex(x, lower, upper, increasing = FALSE, epsim = 0, epsic = 0,visual=TRUE)
```

Arguments

`x`	a numeric vector containing a set of points. The elements of `x` have to be positive and ranked in ascending order. The vector `x` can not contain duplicate data.
`lower`	a numeric vector of the same length as `x` containing the lower limit points. The elements of the vector `lower` have to be non-negative and finite.
`upper`	a numeric vector of the same length as `x` containing the upper limit points. The elements of the vector `upper` have to be non-negative and finite. Furthermore, $L_i \leq U_i, i = 1, \ldots, n$.
`increasing`	a boolean value determining whether to look for an increasing or decreasing pattern. The default value is FALSE.
`epsim`	a non-negative value controlling the monotonicity conditions, $y_{i+1} - y_i \leq (\geq)epsim$, $i = 1, \ldots, n-1$. The default value is 0.
`epsic`	a positive value controlling the convexity condition. For $\alpha_i := (x_i - x_{i+1})/(x_{i-1} - x_{i+1})$ the condition imposed is $y_i - \alpha_i y_{i+1} - (1-\alpha_i)y_{i-1} \leq epsic$, $i = 2, \ldots, n-1$. The default value is 0.
`visual`	a boolean value indicating whether a visual representation of the solution is desired. Here a solution is depicted for all values of x, with linearly interpolated y if $i \notin C$. The default value is TRUE.

Details

The package `DIconvex` is solved as a linear program facilitating `lpSolveAPI`. It lends itself to applications with financial options data. Given a dataset of call or put options, the function maximizes the number of data points such that there exists at least one set of arbitrage-free fundamental option prices within bid and ask spreads.

For this particular application, `x` is the vector of strike prices, `lower` represents the vector of bid prices and `upper` represents the vector of ask prices.

Value

a list containing:

a vector containing $f_1, \ldots, f_n$.

a vector containing y_j, $j \in C$.

a single integer value containing the status code of the underlying linear program. For the interpretation of status codes please see `lpSolveAPI` R documentation. The value 0 signifies success.

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Examples

```
x = c(315, 320, 325, 330, 335, 340, 345, 350)
upper = c(0.5029714, 0.5633280, 0.6840411, 0.8751702, 3.0000000, 1.5692708, 2.3237279, 3.5207998)
lower = c(0.2514857, 0.4325554, 0.4325554, 0.6236845, 2.5000000, 1.1870125, 1.9414696, 3.1385415)

DIconvex(x, lower, upper, increasing = TRUE)

x = c(340, 345, 350, 355, 360, 365)
lower = c(2.7661994, 1.3177168, 1.5029454, 0.1207069, 0.1207069, 0.1207069)
upper = c(3.1383790, 1.5088361, 1.6236522, 0.3721796, 0.1810603, 0.2514727)

DIconvex(x, lower, upper, increasing = FALSE)
```

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