

Package ‘Rdsdp’

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Title R Interface to DSDP Semidefinite Programming Library

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Description R interface to DSDP semidefinite programming library. The DSDP software is a free open source implementation of an interior-point method for semidefinite programming. It provides primal and dual solutions, exploits low-rank structure and sparsity in the data, and has relatively low memory requirements for an interior-point method.

Imports utils, methods

LazyLoad yes

License GPL-3

URL <https://www.mcs.anl.gov/hs/software/DSDP>

NeedsCompilation yes

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Description

Rdsdp is the R package providing a R interface to DSDP semidefinite programming library. The DSDP package implements a dual-scaling algorithm to find solutions (X, y) to linear and semidefinite optimization problems of the form

$$(P) \inf \operatorname{tr}(CX)$$

$$\text{subject to } \mathcal{A}X = b$$

$$X \succeq 0$$

with $(\mathcal{A}X)_i = \operatorname{tr}(A_i X)$ where $X \succeq 0$ means X is positive semidefinite, C and all A_i are symmetric matrices of the same size and b is a vector of length m .

The dual of the problem is

$$(D) \sup b^T y$$

$$\text{subject to } \mathcal{A}^* y + S = C$$

$$S \succeq 0$$

where $\mathcal{A}y = \sum_{i=1}^m y_i A_i$.

Matrices C and A_i are assumed to be block diagonal structured, and must be specified that way (see Details).

References

- <https://www.mcs.anl.gov/hs/software/DSDP/>
- Steven J. Benson and Yinyu Ye:
Algorithm 875: DSDP5 software for semidefinite programming ACM Transactions on Mathematical Software (TOMS) 34(3), 2008
<http://web.stanford.edu/~yyye/DSDP5-Paper.pdf>
- Steven J. Benson and Yinyu Ye and Xiong Zhang:
Solving Large-Scale Sparse Semidefinite Programs for Combinatorial Optimization SIAM Journal on Optimization 10(2):443-461, 2000
<http://web.stanford.edu/~yyye/yyye/largesdp.ps.gz>

Rdsdp::dsdp

Solve semidefinite program with DSDP

Description

Interface to DSDP semidefinite programming library.

Usage

```
dsdp(A,b,C,K,OPTIONS=NULL)
```

Arguments

- | | |
|---------|---|
| A | An object of class "matrix" with m rows defining the block diagonal constraint matrices A_i . Each constraint matrix A_i is specified by a row of A as explained in the Details section. |
| b | A numeric vector of length m containing the right hand side of the constraints. |
| C | An object of class "matrix" with one row or a valid class from the class hierarchy in the "Matrix" package. It defines the objective coefficient matrix C with the same structure of A as explained above. |
| K | Describes the sizes of each block of the sdp problem. It is a list with the following elements:
" s ": A vector of integers listing the dimension of positive semidefinite cone blocks.
" l ": A scalar integer indicating the dimension of the linear nonnegative cone block. |
| OPTIONS | A list of OPTIONS parameters passed to dsdp. It may contain any of the following fields:
print: = k to display output at each k iteration, else = 0 [default 10].
logsummary: = 1 print timing information if set to 1.
save: to set the filename to save solution file in SDPA format.
outputstats: = 1 to output full information about the solution statistics in STATS.
gaptol: tolerance for duality gap as a fraction of the value of the objective functions [default 1e-6].
maxit: maximum number of iterations allowed [default 1000].
Please refer to DSDP User Guide for additional OPTIONS parameters available. |

Details

All problem matrices are assumed to be of block diagonal structure, the input matrix A must be specified as follows:

1. The coefficients for nonnegative cone block are put in the first $K \times 1$ columns of A .

- The coefficients for positive semidefinite cone blocks are put after nonnegative cone block in the the same order as those in `K$s`. The i th positive semidefinite cone block takes `(K$s)[i]` times `(K$s)[[i]]` columns, with each row defining a symmetric matrix of size `(K$s)[[i]]`.

This function does not check for symmetry in the problem data.

Value

Returns a list of three objects:

<code>X</code>	Optimal primal solution X . A vector containing blocks in the same structure as explained above.
<code>y</code>	Optimal dual solution y . A vector of the same length as argument <code>b</code>
<code>STATS</code>	A list with three to eight fields that describe the solution of the problem: <p>stype: <code>PDFeasible</code> if the solutions to both (D) and (P) are feasible, <code>Infeasible</code> if (D) is infeasible, and <code>Unbounded</code> if (D) is unbounded.</p> <p>dobj: objective value of (D).</p> <p>pobj: objective value of (P).</p> <p>r: the multiple of the identity element added to $C - A^*y$ in the final solution to make S positive definite.</p> <p>mu: the final barrier parameter ν.</p> <p>pstep: the final step length in (P)</p> <p>dstep: the final step length in (D)</p> <p>pnorm: the final value $\ P(\nu)\$.</p> <p>The last five fields are optional, and only available when <code>OPTIONS\$outputstats</code> is set to 1.</p>

References

- Steven J. Benson and Yinyu Ye:
DSDP5 User Guide — Software for Semidefinite Programming Technical Report ANL/MCS-TM-277, 2005
<https://www.mcs.anl.gov/hs/software/DSDP/DSDP5-Matlab-UserGuide.pdf>

Examples

```
K=NULL
K$s=c(2,3)
K$l=2

C=matrix(c(0,0,2,1,1,2,c(3,0,1,
              0,2,0,
              1,0,3)),1,15,byrow=TRUE)
A=matrix(c(0,1,0,0,0,0,c(3,0,1,
              0,4,0,
              1,0,5),
              1,0,3,1,1,3,rep(0,9)), 2,15,byrow=TRUE)
b <- c(1,2)
```

```
OPTIONS=NULL
OPTIONS$gaptol=0.000001
OPTIONS$logsummary=0
OPTIONS$outputstats=1

result = dsdp(A,b,C,K,OPTIONS)
```

Rdsdp::dsdp.readsdpa *Solving semidefinite programs reading from SDPA format files.*

Description

Function to read the semidefinite program input data in SDPA format and solve it.

Usage

```
dsdp.readsdpa(sdpa_filename, options_filename="")
```

Arguments

sdpa_filename The location of the SDPA input file.
options_filename The location of the OPTIONS file [default ""].

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