

# Package ‘admmDensestSubmatrix’

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**Type** Package

**Title** Alternating Direction Method of Multipliers to Solve Dense  
Submatrix Problem

**Version** 0.1.0

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**Description** Solves the problem of identifying the densest submatrix in a given or sampled binary matrix, Bombina et al. (2019) <[doi:10.48550/arXiv.1904.03272](https://doi.org/10.48550/arXiv.1904.03272)>.

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**Depends** R (>= 3.5.0)

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**Imports** Rdpack, utils, stats

**RdMacros** Rdpack

**NeedsCompilation** no

**Repository** CRAN

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densub	<i>densub</i>
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### Description

Iteratively solves the convex optimization problem using ADMM.

### Usage

```
densub(G, m, n, tau = 0.35, gamma = 6/(sqrt(m * n) * (q - p)),
      opt_tol = 1e-04, maxiter, quiet = TRUE)
```

### Arguments

G	sampled binary matrix
m	number of rows in dense submatrix
n	number of columns in dense submatrix
tau	penalty parameter for equality constraint violation
gamma	$l_1$ regularization parameter
opt_tol	stopping tolerance in algorithm
maxiter	maximum number of iterations of the algorithm to run
quiet	toggles between displaying intermediate statistics

### Details

$$\min |X|_* + \text{gamma} * |Y|_1 + 1_{\Omega_W}(W) + 1_{\Omega_Q}(Q) + 1_{\Omega_Z}(Z)$$

s.t  $X - Y = 0, X = W, X = Z,$

where  $\Omega_W(W), \Omega_Q(Q), \Omega_Z(Z)$  are the sets:  $\Omega_W = \{W \in \mathbb{R}^{M \times N} | e^T W e = mn$

$$\Omega_Q = \{Q \in \mathbb{R}^{M \times N} | \text{Projection of } Q \text{ on } N = 0$$

$$\Omega_Z = \{Z \in \mathbb{R}^{M \times N} | Z_{ij} \leq 1 \text{ for all } (i, j) \text{ in } M \times N$$

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$1_S$  is the indicator function of the set  $S$  in  $\mathbb{R}^{M \times N}$  such that  $1_S(X) = 0$  if  $X$  in  $S$  and  $+\infty$  otherwise

### Value

Rank one matrix with  $mn$  nonzero entries, matrix  $Y$  that is used to count the number of disagreements between  $G$  and  $X$

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mat_shrink	<i>Soft thresholding operator.</i>
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**Description**

Applies the shrinkage operator for singular value tresholding.

**Usage**

```
mat_shrink(K, tau)
```

**Arguments**

K	matrix
tau	regularization parameter

**Value**

Matrix

**Examples**

```
mat_shrink(matrix(c(1,0,0,0,1,1,1,1,1), nrow=3, ncol=3, byrow=TRUE),0.35)
```

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plantedsubmatrix	<i>Sample matrix</i>
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**Description**

Generates binary  $(M, N)$  - matrix sampled from dense  $(m, n)$  - submatrix.

**Usage**

```
plantedsubmatrix(M, N, m, n, p, q)
```

**Arguments**

M	number of rows in sampled matrix
N	number of rows in sampled matrix
m	number of rows in dense submatrix
n	natural number used to calculate number of rows in dense submatrix
p	density outside planted submatrix
q	density inside planted submatrix

**Details**

Let  $U^*$  and  $V^*$  be  $m$  and  $n$  index sets. For each  $i$  in  $U^*$ ,  $j$  in  $V^*$  we let  $a_{ij} = 1$  with probability  $q$  and 0 otherwise. For each remaining  $ij$  we set  $a_{ij} = 1$  with probability  $p < q$  and take  $a_{ij} = 0$  otherwise.

**Value**

Matrix  $G$  sampled from the planted dense  $(mn)$ -submatrix model, dense submatrix  $X_0$ , matrix  $Y_0$  used to count the number of disagreements between  $G$  and  $X_0$

**Examples**

```
plantedsubmatrix(10,10,1,2,0.25,0.75)
```

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