Model 2

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MODEL, MODEL2 and TwoMODEL are programs from package STRAN – STRucture ANalysis. They are freely available for noncommercial use at

```
http:\\vlado.fmf.uni-lj.si\pub\networks\
```

The program MODEL seeks for the best clustering of a given network satisfying given types of blocks. MODEL2 introduced MDL files to describe the class of possible models – thus superseding the program MODEL. If the MDL file is missing a { nul, com, reg } model is assumed.

Version a added a don't care type; version b a penalty to each MDL file entry; version c extended the maximum size of networks to 100 units; version d introduced two new types: non-null and symmetric; and version e extended the maximum size of networks to 130 units, constraint notin added.

Version h consists of adaption of MODEL2 for Delphi, the maximum size of networks extended to 250 units, the network input files should be in Pajek's NET format. Then a derived program TwoMODEL for generalized blockmodeling of two-mode networks was produced.

Program MODEL2 is also integrated in program Pajek.

The results of the program TwoMODEL are writen as partitions on the file(s) in the Pajek project file PAJ format. This file can be read

```
File / Pajek Project File / Read
```

into Pajek and displayed as a picture

```
Draw / Draw-Partition
Layout / Energy / Kamada-Kawai / Free
```

The result can be displayed also in the matrix form. For two-mode networks this requires several steps:

```
Partitions / First Partition
```: Affiliation partition

```
Partitions / Second Partition
```: Optimal bipartition

```
Partition / Make permutation
File / Network / Export Matrix to EPS / Using Permutation
```; enter file name; yes; yes

1 MDL files

The structure of a MDL file is evident from the following example

```
*MODEL Tina
 9
 0 3 100  0 1 2 3 4
*CONSTRAINTS
 1 100  2 1
 4 100  1 3
*EOM
```

The first character in each line should be a star * or a blank.
The last character in a line should not be a blank.

A number in the second line is the maximal number of allowed clusters. In the program `TwoMODEL` two numbers should be given in this line – the maximal number of row-clusters and the maximal number of col-clusters. The other data are the same for both programs.

The following lines have the structure

$$i \quad j \quad penalty \qquad t_1 \quad t_2 \ldots t_k$$

When $i, j > 0$ the line prescribes that the block (i, j) can be of types $t_1, t_2 \ldots t_k$. The types are coded as follows

```
0   -   -  null                  7  rfn  -  row-function
1  com  -  complete              8  cfn  -  col-function
2  rdo  -  row-dominant          9  den  -  density
3  cdo  -  col-dominant         10  dnc  -  do not care
4  reg  -  regular              11  one  -  non-null
5  rre  -  row-regular          12  sym  -  symmetric
6  cre  -  col-regular
```

Lines with $i = 0$ defines the types of of parts of model matrix:

- $j = 0$: diagonal;
- $j = 1$: upper triangle;
- $j = 2$: lower triangle;
- $j = 3$: complete matrix.

Constraints have the form

$$k \quad penalty \qquad i \quad j$$

with the following meaning

- $k = 1$: $i \in C_j$ – unit i belongs to cluster C_j;
- $k = 2$: $i \notin C_j$ – unit i does not belong to cluster C_j;
- $k = 3$: $C(i) = C(j)$ – units i and j belong to the same cluster;
- $k = 4$: $C(i) \neq C(j)$ – units i and j belong to different
- $k = 5$: $i \leq |C(j)|$ – cluster C_j has at least i units;
- $k = 6$: $i \geq |C(j)|$ – cluster C_j has at most i units.

The violations of constraints contribute to criterion function with a term

$$+ \quad \text{\# of violations} \quad \times \quad \text{penalty}$$

The values of penalties have to be in the range 0 to 1000.

In the case of several lines describing a block the last prescription prevails.
In applications the first $no\text{-}of\text{-}clusters$ rows and columns of model are considered.

2 Examples of `MDL` files

2.1 Regular blocks

```
*MODEL Regular
 10
 0 3   1  0 1 4
*EOM
```

2.2 Diagonal blocks (clustering)

```
*MODEL Diagonal
 10
 0 3 100  0
 0 0   1  0 1 4
*EOM
```

2.3 Acyclic model (up)

```
*MODEL Hierarchy
 9
 0 1   1  0 5 6
 0 0  10  0 1 4 12
 0 2 100  0
*EOM
```

2.4 Acyclic model with symmetric clusters (down)

```
*MODEL SymHiera
 9
 0 0  10  0 1 12
 0 1 100  0
 0 2   1  0 11
*EOM
```

2.5 Center-Periphery

```
*MODEL Center-Periphery
 2
 0 3   1   0 11
 2 2  10   0
 1 1 100   0 1 4
*EOM
```

2.6 Regular path

```
*MODEL Regular Path
 9
 0 0 10  0 1 4
 1 2 10  0 1 4
 2 3 10  0 1 4
 3 4 10  0 1 4
 4 5 10  0 1 4
 5 6 10  0 1 4
 6 7 10  0 1 4
 7 8 10  0 1 4
 8 9 10  0 1 4
*EOM
```

2.7 Regular chain

```
*MODEL Regular Chain
 9
 0 0 10  0 1 4
```

```
 1 2 10  0 1 4
 2 3 10  0 1 4
 3 4 10  0 1 4
 4 5 10  0 1 4
 5 6 10  0 1 4
 6 7 10  0 1 4
 7 8 10  0 1 4
 8 9 10  0 1 4
 2 1 10  0 1 4
 3 2 10  0 1 4
 4 3 10  0 1 4
 5 4 10  0 1 4
 6 5 10  0 1 4
 7 6 10  0 1 4
 8 7 10  0 1 4
 9 8 10  0 1 4
*EOM
```