
Algorithm 1 Pseudocode for interchange procedure

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1:  $\mathbf{X}$  = design matrix for starting design
2: Set  $\mathbf{X}_{opt} \leftarrow \mathbf{X}$ ;  $d_{opt} \leftarrow |\mathbf{X}'\mathbf{X}|$ ;  $s \leftarrow 0$ ;  $s_{max} = 20$ 
3: repeat
4:    $s \leftarrow s + 1$ 
5:   Randomly permute foldover pairs giving starting design  $s$ 
6:    $\mathbf{X} \leftarrow$  design matrix of starting design  $s$ 
7:    $d_{best} \leftarrow |\mathbf{X}'\mathbf{X}|$ 
8:   repeat
9:     if  $c > 0$  then
10:      Set row value to  $r = m'$ 
11:      repeat
12:        Set  $r \leftarrow r + 1$ ;  $c_{index} \leftarrow 0$ 
13:        repeat
14:           $\mathbf{X}_t \leftarrow \mathbf{X}$ ;  $c_{index} \leftarrow c_{index} + 1$ 
15:          Change sign of categorical factor  $c_{index}$  in row  $r$  of  $\mathbf{X}_t$ 
16:          Change sign of mirror image of factor  $c_{index}$  in mirror image row of  $\mathbf{X}_t$ 
17:           $d_t \leftarrow |\mathbf{X}_t'\mathbf{X}_t|$ 
18:          if  $d_t > d_{best}$  then
19:             $d_{best} \leftarrow d_t$ ;  $\mathbf{X} \leftarrow \mathbf{X}_t$ 
20:          end if
21:        until  $c_{index} = c$ 
22:      until  $r = m' + 2c$ 
23:    end if
24:     $r \leftarrow 0$ 
25:    repeat
26:      Set  $r \leftarrow r + 1$ ;  $\mathbf{b} \leftarrow [b_1, \dots, b_n]'$ ;  $\mathbf{b}^t \leftarrow \mathbf{b}$ ;  $i \leftarrow 0$  (block index)
27:      repeat
28:         $i \leftarrow i + 1$ 
29:        if  $\mathbf{b}_{2r-1}^t \neq \mathbf{b}_{2i-1}$  then
30:           $\mathbf{b}^t \leftarrow \mathbf{b}_{2r-1}^t$ ;  $\mathbf{b}_{2r-1}^t \leftarrow \mathbf{b}_{2i-1}$ ;  $\mathbf{b}_{2r}^t \leftarrow \mathbf{b}_{2i-1}$ ;  $\mathbf{b}_{2i-1}^t \leftarrow \mathbf{b}^t$ ;  $\mathbf{b}_{2i}^t \leftarrow \mathbf{b}^t$ 
31:        end if
32:        if all blocks are present in  $\mathbf{b}^t$  then
33:           $\mathbf{X}_t \leftarrow$  design matrix based on  $\mathbf{b}^t$ ;  $d_t \leftarrow |\mathbf{X}_t'\mathbf{X}_t|$ 
34:          if  $d_t > d_{best}$  then
35:             $d_{best} \leftarrow d_t$ ;  $\mathbf{X} \leftarrow \mathbf{X}_t$ ;  $\mathbf{b} \leftarrow \mathbf{b}^t$ 
36:          end if
37:        end if
38:      until  $i = n/2$ 
39:    until  $r = n/2$ 
40:  until No further improvements
41:  if  $d_{best} > d_{opt}$  then
42:     $d_{opt} \leftarrow d_{best}$ ;  $\mathbf{X}_{opt} \leftarrow \mathbf{X}$ 
43:  end if
44: until  $s = s_{max}$ 
45: STOP
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