

# ORDER SCHEDULING IN AN ENVIRONMENT WITH DEDICATED RESOURCES IN PARALLEL

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## EXPERIMENTAL RESULTS FOR $PD \parallel \sum C_j$

Detailed experimental results are shown in Tables I to VIII.



Table I. Comparative overview of performance of heuristics for  $\sum C_j : n = 20; m = 2, 5$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 2        | 1  | 9394        | 9659        | 9377        | 9154        | 8925       | ECT                    | 8829      | 1.1        | 0.00                      | 21                         |
|          | 2  | 9912        | 10474       | 10268       | 9698        | 9773       | SPTL                   | 9631      | 0.7        | 0.01                      | 23                         |
|          | 3  | 10356       | 10811       | 10112       | 10113       | 9591       | ECT                    | 9400      | 2.0        | 0.00                      | 21                         |
|          | 4  | 8405        | 8278        | 8257        | 8160        | 7968       | ECT                    | 7922      | 0.6        | 0.00                      | 21                         |
|          | 5  | 8345        | 8311        | 8053        | 8149        | 7864       | ECT                    | 7860      | 0.1        | 0.00                      | 21                         |
|          | 6  | 9172        | 9650        | 9750        | 9159        | 9044       | ECT                    | 8997      | 0.5        | 0.00                      | 21                         |
|          | 7  | 8385        | 8067        | 8131        | 8261        | 8011       | ECT                    | 7901      | 1.4        | 0.01                      | 21                         |
|          | 8  | 10551       | 10363       | 10569       | 10431       | 10171      | ECT                    | 10134     | 0.4        | 0.01                      | 21                         |
|          | 9  | 7731        | 7805        | 7718        | 7672        | 7605       | ECT                    | 7564      | 0.5        | 0.01                      | 21                         |
|          | 10 | 11215       | 11532       | 10945       | 10437       | 10356      | ECT                    | 10140     | 2.1        | 0.00                      | 21                         |
|          | 11 | 10983       | 11380       | 10929       | 10830       | 10183      | ECT                    | 10093     | 0.9        | 0.00                      | 21                         |
|          | 12 | 9449        | 9735        | 9682        | 9516        | 9371       | ECT                    | 9324      | 0.5        | 0.01                      | 21                         |
|          | 13 | 5938        | 5975        | 5541        | 5858        | 5413       | ECT                    | 5400      | 0.2        | 0.00                      | 21                         |
|          | 14 | 5017        | 5225        | 4784        | 4823        | 4617       | ECT                    | 4499      | 2.6        | 0.00                      | 21                         |
|          | 15 | 5503        | 5931        | 5688        | 5695        | 5381       | ECT                    | 5306      | 1.4        | 0.00                      | 21                         |
|          | 16 | 5189        | 5218        | 5141        | 5594        | 4907       | ECT                    | 4811      | 2.0        | 0.00                      | 21                         |
|          | 17 | 10100       | 9923        | 9150        | 9045        | 8990       | ECT                    | 8964      | 0.3        | 0.00                      | 21                         |
|          | 18 | 7025        | 7200        | 7028        | 7009        | 6741       | ECT                    | 6556      | 2.8        | 0.01                      | 22                         |
|          | 19 | 6490        | 6774        | 6799        | 6531        | 6429       | ECT                    | 6277      | 2.4        | 0.01                      | 21                         |
|          | 20 | 7440        | 7363        | 6907        | 6857        | 6643       | ECT                    | 6620      | 0.3        | 0.00                      | 21                         |
|          | 21 | 7053        | 7319        | 7160        | 6720        | 6918       | SPTL                   | 6682      | 0.6        | 0.00                      | 23                         |
|          | 22 | 6579        | 6830        | 6367        | 6589        | 6088       | ECT                    | 5956      | 2.2        | 0.00                      | 22                         |
|          | 23 | 7496        | 8221        | 7547        | 7583        | 7265       | ECT                    | 7111      | 2.2        | 0.00                      | 21                         |
|          | 24 | 6881        | 6813        | 6596        | 6766        | 6447       | ECT                    | 6439      | 0.1        | 0.01                      | 21                         |
|          | 25 | 5443        | 5380        | 5125        | 5368        | 5045       | ECT                    | 5031      | 0.3        | 0.00                      | 21                         |
|          | 26 | 4526        | 4710        | 4500        | 4371        | 4191       | ECT                    | 4153      | 0.9        | 0.00                      | 21                         |
|          | 27 | 6090        | 6215        | 5919        | 6050        | 5790       | ECT                    | 5581      | 3.7        | 0.01                      | 21                         |
|          | 28 | 5124        | 5344        | 5201        | 5249        | 5070       | ECT                    | 4925      | 2.9        | 0.00                      | 21                         |
|          | 29 | 6195        | 6146        | 5852        | 6362        | 5824       | ECT                    | 5753      | 1.2        | 0.01                      | 21                         |
|          | 30 | 6047        | 6408        | 6350        | 6237        | 6175       | STPT                   | 5903      | 2.4        | 0.01                      | 21                         |
| 5        | 1  | 6359        | 5685        | 5243        | 5230        | 5201       | ECT                    | 4879      | 6.6        | 0.00                      | 31                         |
|          | 2  | 4303        | 4501        | 4254        | 4185        | 4067       | ECT                    | 3978      | 2.2        | 0.00                      | 24                         |
|          | 3  | 5502        | 6324        | 5129        | 4812        | 4672       | ECT                    | 4564      | 2.4        | 0.00                      | 48                         |
|          | 4  | 4573        | 4685        | 4447        | 4482        | 4264       | ECT                    | 4076      | 4.6        | 0.00                      | 23                         |
|          | 5  | 4447        | 4633        | 4380        | 4357        | 4070       | ECT                    | 4000      | 1.8        | 0.01                      | 24                         |
|          | 6  | 5658        | 5682        | 5315        | 5460        | 4960       | ECT                    | 4838      | 2.5        | 0.00                      | 27                         |
|          | 7  | 10981       | 11405       | 11029       | 10981       | 10438      | ECT                    | 10393     | 0.4        | 0.01                      | 26                         |
|          | 8  | 12034       | 12059       | 11799       | 11073       | 11105      | SPTL                   | 10856     | 2.0        | 0.01                      | 33                         |
|          | 9  | 12646       | 13079       | 12942       | 12168       | 12040      | ECT                    | 11796     | 2.1        | 0.00                      | 27                         |
|          | 10 | 12743       | 12564       | 12399       | 12661       | 12036      | ECT                    | 11951     | 0.7        | 0.00                      | 27                         |
|          | 11 | 12900       | 12728       | 12603       | 12291       | 12182      | ECT                    | 12104     | 0.6        | 0.00                      | 29                         |
|          | 12 | 10730       | 10504       | 10682       | 10799       | 10225      | ECT                    | 9894      | 3.3        | 0.00                      | 36                         |
|          | 13 | 9259        | 8106        | 7999        | 8036        | 7633       | ECT                    | 7477      | 2.1        | 0.01                      | 29                         |
|          | 14 | 6023        | 6811        | 6151        | 5810        | 5608       | ECT                    | 5390      | 4.0        | 0.00                      | 45                         |
|          | 15 | 5677        | 5122        | 5252        | 5201        | 4905       | ECT                    | 4742      | 3.4        | 0.00                      | 31                         |
|          | 16 | 5742        | 5901        | 5814        | 5618        | 5461       | ECT                    | 5413      | 0.9        | 0.00                      | 29                         |
|          | 17 | 6775        | 7259        | 6399        | 5770        | 5742       | ECT                    | 5599      | 2.6        | 0.01                      | 28                         |
|          | 18 | 6491        | 6947        | 6619        | 6488        | 6348       | ECT                    | 6237      | 1.8        | 0.01                      | 28                         |
|          | 19 | 5615        | 5720        | 5352        | 5245        | 5010       | ECT                    | 4844      | 3.4        | 0.00                      | 27                         |
|          | 20 | 6217        | 5849        | 6058        | 5835        | 5647       | ECT                    | 5543      | 1.9        | 0.01                      | 30                         |
|          | 21 | 10803       | 9924        | 9060        | 9294        | 8772       | ECT                    | 8697      | 0.9        | 0.01                      | 33                         |
|          | 22 | 5613        | 5756        | 5486        | 5413        | 5167       | ECT                    | 5131      | 0.7        | 0.01                      | 27                         |
|          | 23 | 8189        | 7220        | 7061        | 7022        | 6831       | ECT                    | 6746      | 1.3        | 0.00                      | 42                         |
|          | 24 | 9983        | 10089       | 9085        | 8501        | 8188       | ECT                    | 8147      | 0.5        | 0.01                      | 31                         |
|          | 25 | 5797        | 5509        | 5421        | 5399        | 5146       | ECT                    | 5047      | 2.0        | 0.01                      | 33                         |
|          | 26 | 7886        | 7711        | 7240        | 7129        | 6790       | ECT                    | 6704      | 1.3        | 0.00                      | 33                         |
|          | 27 | 6763        | 7087        | 6332        | 6199        | 6004       | ECT                    | 5884      | 2.0        | 0.00                      | 29                         |
|          | 28 | 6031        | 6047        | 5328        | 5523        | 5141       | ECT                    | 5134      | 0.1        | 0.00                      | 31                         |
|          | 29 | 5622        | 6077        | 5363        | 5301        | 4905       | ECT                    | 4836      | 1.4        | 0.01                      | 30                         |
|          | 30 | 5784        | 5656        | 5463        | 5524        | 5037       | ECT                    | 4938      | 2.0        | 0.00                      | 34                         |

Table II. Comparative overview of performance of heuristics for  $\sum C_j : n = 20; m = 10, 20$ 

| $m$ | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | $H_{min}$ | <i>TS</i> | <i>Imp</i> | $T_h($ Sec) | $T_{ts}($ Sec) |
|-----|----|-------------|-------------|-------------|-------------|------------|-----------|-----------|------------|-------------|----------------|
| 10  | 1  | 4664        | 5227        | 3743        | 3952        | 3523       | ECT       | 3523      | 0.0        | 0.00        | 31             |
|     | 2  | 3288        | 3516        | 3092        | 3232        | 2790       | ECT       | 2763      | 1.0        | 0.00        | 32             |
|     | 3  | 4841        | 4199        | 3738        | 4259        | 3451       | ECT       | 3342      | 3.3        | 0.00        | 30             |
|     | 4  | 3250        | 3254        | 2694        | 3056        | 2616       | ECT       | 2598      | 0.7        | 0.01        | 56             |
|     | 5  | 3792        | 4386        | 3729        | 3854        | 3484       | ECT       | 3447      | 1.1        | 0.01        | 33             |
|     | 6  | 3587        | 3909        | 3452        | 3381        | 3102       | ECT       | 3035      | 2.2        | 0.00        | 32             |
|     | 7  | 13359       | 13735       | 12662       | 12783       | 12489      | ECT       | 12144     | 2.8        | 0.01        | 64             |
|     | 8  | 13028       | 13652       | 12447       | 12549       | 12213      | ECT       | 11819     | 3.3        | 0.00        | 47             |
|     | 9  | 12365       | 12424       | 12238       | 11911       | 11790      | ECT       | 11445     | 3.0        | 0.00        | 48             |
|     | 10 | 12542       | 13106       | 12250       | 12068       | 11674      | ECT       | 11585     | 0.8        | 0.00        | 43             |
|     | 11 | 12106       | 12115       | 12273       | 11961       | 11272      | ECT       | 11159     | 1.0        | 0.01        | 44             |
|     | 12 | 14206       | 13649       | 13217       | 13234       | 12749      | ECT       | 12698     | 0.4        | 0.00        | 39             |
|     | 13 | 5857        | 6536        | 6323        | 5915        | 5650       | ECT       | 5593      | 1.0        | 0.00        | 51             |
|     | 14 | 5818        | 6375        | 5830        | 5543        | 5661       | SPTL      | 5263      | 5.3        | 0.00        | 34             |
|     | 15 | 5823        | 5840        | 5417        | 5241        | 4856       | ECT       | 4771      | 1.8        | 0.01        | 33             |
|     | 16 | 7550        | 7631        | 7635        | 7194        | 6828       | ECT       | 6688      | 2.1        | 0.01        | 37             |
|     | 17 | 6232        | 5921        | 5949        | 5457        | 5160       | ECT       | 5070      | 1.8        | 0.01        | 39             |
|     | 18 | 6340        | 7395        | 7067        | 5844        | 5715       | ECT       | 5668      | 0.8        | 0.01        | 48             |
|     | 19 | 6614        | 7445        | 5727        | 5586        | 5428       | ECT       | 5358      | 1.3        | 0.01        | 37             |
|     | 20 | 6852        | 7145        | 6400        | 5924        | 5661       | ECT       | 5574      | 1.6        | 0.01        | 75             |
|     | 21 | 6441        | 7070        | 6541        | 6253        | 6027       | ECT       | 5911      | 2.0        | 0.01        | 37             |
|     | 22 | 8361        | 8058        | 8175        | 7261        | 7253       | ECT       | 6994      | 3.7        | 0.00        | 42             |
|     | 23 | 6994        | 7851        | 6811        | 6761        | 6252       | ECT       | 6252      | 0.0        | 0.01        | 34             |
|     | 24 | 9392        | 8367        | 8144        | 7773        | 7492       | ECT       | 7279      | 2.9        | 0.01        | 50             |
|     | 25 | 4196        | 4398        | 4295        | 4291        | 4044       | ECT       | 3885      | 4.1        | 0.01        | 32             |
|     | 26 | 6079        | 6266        | 6243        | 5709        | 5562       | ECT       | 5437      | 2.3        | 0.00        | 33             |
|     | 27 | 6588        | 7852        | 7234        | 6093        | 5807       | ECT       | 5621      | 3.3        | 0.01        | 33             |
|     | 28 | 5435        | 5943        | 5435        | 5239        | 4807       | ECT       | 4802      | 0.1        | 0.00        | 32             |
|     | 29 | 8270        | 7774        | 7218        | 6599        | 6319       | ECT       | 6253      | 1.1        | 0.01        | 33             |
|     | 30 | 7055        | 6578        | 6951        | 6474        | 6076       | ECT       | 5897      | 3.0        | 0.00        | 35             |
| 20  | 1  | 3190        | 3114        | 2532        | 2846        | 2414       | ECT       | 2393      | 0.9        | 0.00        | 65             |
|     | 2  | 4729        | 4092        | 2858        | 3174        | 2734       | ECT       | 2721      | 0.5        | 0.01        | 57             |
|     | 3  | 2589        | 2648        | 2209        | 2314        | 2066       | ECT       | 2041      | 1.2        | 0.01        | 44             |
|     | 4  | 2509        | 2886        | 2277        | 2525        | 2177       | ECT       | 2177      | 0.0        | 0.01        | 33             |
|     | 5  | 3760        | 3401        | 2993        | 3474        | 2843       | ECT       | 2843      | 0.0        | 0.00        | 37             |
|     | 6  | 2700        | 2795        | 2389        | 2523        | 2233       | ECT       | 2233      | 0.0        | 0.00        | 32             |
|     | 7  | 13157       | 12390       | 12713       | 12352       | 11717      | ECT       | 11578     | 1.2        | 0.00        | 91             |
|     | 8  | 14013       | 13750       | 13355       | 13320       | 12881      | ECT       | 12584     | 2.4        | 0.01        | 64             |
|     | 9  | 13068       | 13500       | 13078       | 12470       | 12180      | ECT       | 11979     | 1.7        | 0.01        | 115            |
|     | 10 | 13531       | 13888       | 13780       | 12989       | 12654      | ECT       | 12448     | 1.7        | 0.01        | 59             |
|     | 11 | 12362       | 12761       | 12507       | 12394       | 11765      | ECT       | 11354     | 3.6        | 0.00        | 76             |
|     | 12 | 12722       | 14171       | 13690       | 13025       | 12689      | ECT       | 12244     | 3.6        | 0.00        | 84             |
|     | 13 | 8078        | 8825        | 8226        | 7705        | 7470       | ECT       | 7356      | 1.5        | 0.00        | 45             |
|     | 14 | 9154        | 9385        | 9128        | 8698        | 8515       | ECT       | 7984      | 6.7        | 0.01        | 48             |
|     | 15 | 7907        | 8997        | 7885        | 7226        | 7188       | ECT       | 7047      | 2.0        | 0.01        | 41             |
|     | 16 | 7251        | 7604        | 7644        | 6773        | 6535       | ECT       | 6459      | 1.2        | 0.00        | 42             |
|     | 17 | 7312        | 9301        | 7936        | 6992        | 6873       | ECT       | 6820      | 0.8        | 0.00        | 43             |
|     | 18 | 5452        | 6154        | 5451        | 5029        | 4616       | ECT       | 4532      | 1.9        | 0.01        | 46             |
|     | 19 | 6614        | 7011        | 6888        | 6315        | 6226       | ECT       | 6001      | 3.7        | 0.01        | 42             |
|     | 20 | 8366        | 9251        | 8773        | 7974        | 7708       | ECT       | 7588      | 1.6        | 0.01        | 43             |
|     | 21 | 6025        | 6997        | 6122        | 5759        | 5194       | ECT       | 5003      | 3.8        | 0.01        | 41             |
|     | 22 | 5691        | 6213        | 6007        | 5605        | 5338       | ECT       | 5165      | 3.3        | 0.00        | 43             |
|     | 23 | 7445        | 8492        | 7622        | 6560        | 6351       | ECT       | 6209      | 2.3        | 0.00        | 44             |
|     | 24 | 7230        | 7903        | 7126        | 6856        | 6448       | ECT       | 6432      | 0.2        | 0.01        | 42             |
|     | 25 | 7445        | 8251        | 7580        | 7108        | 6658       | ECT       | 6631      | 0.4        | 0.00        | 45             |
|     | 26 | 8532        | 7849        | 7521        | 7282        | 6846       | ECT       | 6767      | 1.2        | 0.00        | 45             |
|     | 27 | 8370        | 9872        | 8748        | 8150        | 7733       | ECT       | 7537      | 2.6        | 0.01        | 72             |
|     | 28 | 7290        | 7617        | 6922        | 6391        | 6159       | ECT       | 6008      | 2.5        | 0.01        | 41             |
|     | 29 | 7413        | 8524        | 7907        | 6927        | 6874       | ECT       | 6616      | 3.9        | 0.00        | 46             |
|     | 30 | 8629        | 9685        | 8628        | 8270        | 7947       | ECT       | 7632      | 4.1        | 0.01        | 46             |

Table III. Comparative overview of performance of heuristics for  $\sum C_j : n = 50; m = 2, 5$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 2        | 1  | 55059       | 57124       | 56877       | 55225       | 55233      | STPT                   | 53943     | 2.1        | 0.00                      | 136                        |
|          | 2  | 64070       | 62374       | 61649       | 61300       | 60232      | ECT                    | 59333     | 1.5        | 0.00                      | 139                        |
|          | 3  | 56442       | 59004       | 58492       | 57849       | 57039      | STPT                   | 55667     | 1.4        | 0.01                      | 149                        |
|          | 4  | 51924       | 52572       | 52163       | 51486       | 50996      | ECT                    | 49920     | 2.2        | 0.00                      | 177                        |
|          | 5  | 50350       | 51255       | 50159       | 50237       | 48119      | ECT                    | 47586     | 1.1        | 0.00                      | 290                        |
|          | 6  | 54309       | 56097       | 56501       | 54753       | 53825      | ECT                    | 52978     | 1.6        | 0.01                      | 141                        |
|          | 7  | 51163       | 52608       | 51649       | 51241       | 50216      | ECT                    | 49300     | 1.9        | 0.00                      | 150                        |
|          | 8  | 54104       | 56537       | 55719       | 55324       | 54258      | STPT                   | 52839     | 2.4        | 0.01                      | 147                        |
|          | 9  | 49520       | 51916       | 51335       | 50329       | 48814      | ECT                    | 48161     | 1.4        | 0.01                      | 143                        |
|          | 10 | 51727       | 51349       | 50765       | 51864       | 48824      | ECT                    | 48120     | 1.5        | 0.01                      | 204                        |
|          | 11 | 48595       | 50335       | 50100       | 50192       | 49149      | STPT                   | 48108     | 1.0        | 0.00                      | 175                        |
|          | 12 | 48925       | 49092       | 48726       | 49365       | 46875      | ECT                    | 46351     | 1.1        | 0.01                      | 221                        |
|          | 13 | 34765       | 37317       | 36036       | 34982       | 34155      | ECT                    | 32963     | 3.6        | 0.01                      | 132                        |
|          | 14 | 30949       | 32039       | 31799       | 31709       | 30782      | ECT                    | 29891     | 3.0        | 0.00                      | 125                        |
|          | 15 | 38261       | 40328       | 39464       | 37637       | 37218      | ECT                    | 36299     | 2.5        | 0.01                      | 171                        |
|          | 16 | 36810       | 38635       | 37022       | 36375       | 36181      | ECT                    | 34506     | 4.9        | 0.00                      | 145                        |
|          | 17 | 33810       | 36328       | 35613       | 36512       | 34567      | STPT                   | 33158     | 2.0        | 0.01                      | 151                        |
|          | 18 | 44473       | 43577       | 41993       | 41478       | 40174      | ECT                    | 39524     | 1.6        | 0.00                      | 163                        |
|          | 19 | 36695       | 39387       | 38036       | 36323       | 35241      | ECT                    | 34686     | 1.6        | 0.01                      | 165                        |
|          | 20 | 36312       | 39445       | 38668       | 36619       | 36316      | STPT                   | 35075     | 3.5        | 0.01                      | 147                        |
|          | 21 | 37532       | 40009       | 36950       | 34869       | 34660      | ECT                    | 33609     | 3.1        | 0.00                      | 134                        |
|          | 22 | 35573       | 37694       | 35387       | 36544       | 34029      | ECT                    | 33084     | 2.9        | 0.00                      | 124                        |
|          | 23 | 37426       | 40392       | 39542       | 37675       | 38504      | STPT                   | 36907     | 1.4        | 0.01                      | 123                        |
|          | 24 | 30919       | 31672       | 31195       | 31685       | 30167      | ECT                    | 28888     | 4.4        | 0.01                      | 124                        |
|          | 25 | 30700       | 31050       | 30316       | 30602       | 28947      | ECT                    | 28675     | 0.9        | 0.00                      | 128                        |
|          | 26 | 35198       | 37017       | 35679       | 34088       | 34182      | SPTL                   | 33173     | 2.8        | 0.00                      | 167                        |
|          | 27 | 36607       | 38097       | 36344       | 36113       | 35472      | ECT                    | 34380     | 3.2        | 0.01                      | 168                        |
|          | 28 | 32896       | 33422       | 31832       | 32316       | 31084      | ECT                    | 30490     | 1.9        | 0.00                      | 158                        |
|          | 29 | 33559       | 36046       | 34982       | 34504       | 33721      | STPT                   | 32597     | 3.0        | 0.00                      | 143                        |
|          | 30 | 31546       | 33088       | 32137       | 30367       | 30497      | SPTL                   | 29682     | 2.3        | 0.01                      | 130                        |
| 5        | 1  | 27295       | 30558       | 26623       | 25478       | 24525      | ECT                    | 24205     | 1.3        | 0.01                      | 237                        |
|          | 2  | 27738       | 25980       | 24817       | 25080       | 23389      | ECT                    | 23062     | 1.4        | 0.01                      | 244                        |
|          | 3  | 27301       | 29618       | 24375       | 22970       | 22260      | ECT                    | 21759     | 2.3        | 0.01                      | 383                        |
|          | 4  | 27889       | 28595       | 25026       | 24543       | 23296      | ECT                    | 22718     | 2.5        | 0.01                      | 209                        |
|          | 5  | 26565       | 27052       | 25002       | 24507       | 23523      | ECT                    | 23133     | 1.7        | 0.00                      | 341                        |
|          | 6  | 24983       | 26682       | 24171       | 23313       | 22167      | ECT                    | 22109     | 0.3        | 0.00                      | 206                        |
|          | 7  | 58417       | 60555       | 59304       | 60322       | 56322      | ECT                    | 55386     | 1.7        | 0.00                      | 226                        |
|          | 8  | 63849       | 67408       | 66011       | 62817       | 61348      | ECT                    | 60333     | 1.7        | 0.00                      | 316                        |
|          | 9  | 66005       | 68380       | 68893       | 64572       | 63534      | ECT                    | 61782     | 2.8        | 0.00                      | 405                        |
|          | 10 | 71810       | 71761       | 68496       | 64616       | 62550      | ECT                    | 61820     | 1.2        | 0.00                      | 267                        |
|          | 11 | 63026       | 63662       | 62757       | 59737       | 58838      | ECT                    | 58110     | 1.3        | 0.00                      | 646                        |
|          | 12 | 60083       | 65399       | 63820       | 59517       | 58901      | ECT                    | 57282     | 2.8        | 0.00                      | 381                        |
|          | 13 | 41643       | 41011       | 38061       | 35142       | 34170      | ECT                    | 33395     | 2.3        | 0.00                      | 396                        |
|          | 14 | 33437       | 34108       | 32108       | 30802       | 29718      | ECT                    | 29044     | 2.3        | 0.00                      | 450                        |
|          | 15 | 36269       | 40501       | 38017       | 33643       | 32975      | ECT                    | 32232     | 2.3        | 0.00                      | 201                        |
|          | 16 | 30647       | 34331       | 33336       | 28579       | 28065      | ECT                    | 26879     | 4.4        | 0.00                      | 178                        |
|          | 17 | 33384       | 38203       | 37287       | 33355       | 33337      | ECT                    | 31441     | 6.0        | 0.01                      | 540                        |
|          | 18 | 33107       | 36818       | 34196       | 30509       | 30706      | SPTL                   | 28677     | 6.4        | 0.01                      | 188                        |
|          | 19 | 31019       | 31883       | 32765       | 29562       | 29254      | ECT                    | 28607     | 2.3        | 0.01                      | 265                        |
|          | 20 | 26907       | 28849       | 27555       | 26684       | 25049      | ECT                    | 24379     | 2.7        | 0.01                      | 367                        |
|          | 21 | 41322       | 48013       | 43449       | 39219       | 38345      | ECT                    | 37347     | 2.7        | 0.01                      | 281                        |
|          | 22 | 36981       | 37516       | 34818       | 32402       | 32214      | ECT                    | 30681     | 5.0        | 0.01                      | 548                        |
|          | 23 | 46709       | 44546       | 42356       | 40233       | 39099      | ECT                    | 38058     | 2.7        | 0.01                      | 252                        |
|          | 24 | 30555       | 31944       | 30379       | 27052       | 26902      | ECT                    | 25827     | 4.2        | 0.01                      | 496                        |
|          | 25 | 45284       | 44881       | 42602       | 40364       | 39044      | ECT                    | 38154     | 2.3        | 0.01                      | 188                        |
|          | 26 | 33198       | 33937       | 32499       | 30330       | 29489      | ECT                    | 28682     | 2.8        | 0.00                      | 190                        |
|          | 27 | 38139       | 40845       | 37680       | 34779       | 34664      | ECT                    | 33680     | 2.9        | 0.00                      | 189                        |
|          | 28 | 37912       | 41316       | 36999       | 34132       | 32591      | ECT                    | 31345     | 4.0        | 0.01                      | 285                        |
|          | 29 | 35377       | 37438       | 36583       | 33997       | 33704      | ECT                    | 32626     | 3.3        | 0.01                      | 190                        |
|          | 30 | 37459       | 40889       | 39981       | 36473       | 35546      | ECT                    | 34745     | 2.3        | 0.01                      | 330                        |

Table IV. Comparative overview of performance of heuristics for  $\sum C_j : n = 50; m = 10, 20$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 10       | 1  | 16445       | 16928       | 14493       | 15535       | 13153      | ECT                    | 13010     | 1.1        | 0.01                      | 225                        |
|          | 2  | 19802       | 19869       | 16307       | 17863       | 15007      | ECT                    | 14860     | 1.0        | 0.01                      | 427                        |
|          | 3  | 16871       | 16939       | 14287       | 15305       | 12653      | ECT                    | 12533     | 1.0        | 0.01                      | 709                        |
|          | 4  | 15390       | 16025       | 13165       | 14175       | 12008      | ECT                    | 11902     | 0.9        | 0.00                      | 201                        |
|          | 5  | 16489       | 17031       | 13844       | 15395       | 12743      | ECT                    | 12732     | 0.1        | 0.01                      | 596                        |
|          | 6  | 15104       | 15683       | 13650       | 14104       | 11914      | ECT                    | 11811     | 0.9        | 0.01                      | 364                        |
|          | 7  | 65146       | 69757       | 66899       | 63736       | 61760      | ECT                    | 60619     | 1.9        | 0.01                      | 1023                       |
|          | 8  | 69024       | 72769       | 70631       | 67468       | 65397      | ECT                    | 64191     | 1.9        | 0.01                      | 458                        |
|          | 9  | 65593       | 71470       | 68701       | 65997       | 62926      | ECT                    | 61254     | 2.7        | 0.01                      | 518                        |
|          | 10 | 69901       | 76242       | 72376       | 70784       | 67438      | ECT                    | 66041     | 2.1        | 0.00                      | 598                        |
|          | 11 | 68661       | 71489       | 70365       | 67661       | 64924      | ECT                    | 63438     | 2.3        | 0.00                      | 869                        |
|          | 12 | 71462       | 74963       | 72780       | 71077       | 68116      | ECT                    | 67647     | 0.7        | 0.00                      | 1078                       |
|          | 13 | 39470       | 43744       | 42157       | 36566       | 34935      | ECT                    | 34287     | 1.9        | 0.00                      | 355                        |
|          | 14 | 29734       | 32473       | 32257       | 28357       | 27134      | ECT                    | 26469     | 2.5        | 0.00                      | 417                        |
|          | 15 | 34369       | 36647       | 34446       | 32330       | 30500      | ECT                    | 29951     | 1.8        | 0.00                      | 566                        |
|          | 16 | 36813       | 39809       | 38865       | 33681       | 32356      | ECT                    | 31405     | 2.8        | 0.00                      | 354                        |
|          | 17 | 32748       | 38567       | 35314       | 31197       | 30150      | ECT                    | 29053     | 3.8        | 0.00                      | 653                        |
|          | 18 | 31250       | 37167       | 33322       | 29604       | 28476      | ECT                    | 27754     | 2.6        | 0.01                      | 270                        |
|          | 19 | 46213       | 49030       | 42724       | 38334       | 36593      | ECT                    | 36078     | 1.4        | 0.01                      | 372                        |
|          | 20 | 27082       | 32314       | 31148       | 26363       | 24912      | ECT                    | 24745     | 0.7        | 0.01                      | 264                        |
|          | 21 | 30163       | 37160       | 34061       | 28801       | 27128      | ECT                    | 26679     | 1.7        | 0.01                      | 683                        |
|          | 22 | 36538       | 41095       | 38867       | 34356       | 33205      | ECT                    | 32469     | 2.3        | 0.01                      | 956                        |
|          | 23 | 38075       | 42458       | 36689       | 33060       | 32150      | ECT                    | 31393     | 2.4        | 0.01                      | 312                        |
|          | 24 | 34890       | 35221       | 34208       | 33127       | 31505      | ECT                    | 30695     | 2.6        | 0.01                      | 441                        |
|          | 25 | 36871       | 39091       | 40106       | 34239       | 33139      | ECT                    | 32163     | 3.0        | 0.01                      | 294                        |
|          | 26 | 40009       | 41748       | 38859       | 34735       | 34582      | ECT                    | 33094     | 4.5        | 0.01                      | 286                        |
|          | 27 | 34056       | 37911       | 35581       | 31243       | 30822      | ECT                    | 29468     | 4.6        | 0.01                      | 647                        |
|          | 28 | 28227       | 31970       | 30391       | 27370       | 25931      | ECT                    | 25276     | 2.6        | 0.01                      | 303                        |
|          | 29 | 30336       | 33376       | 31835       | 28940       | 28414      | ECT                    | 27443     | 3.5        | 0.00                      | 257                        |
|          | 30 | 38919       | 45725       | 39956       | 34883       | 33614      | ECT                    | 32650     | 3.0        | 0.01                      | 298                        |
| 20       | 1  | 11257       | 10693       | 9009        | 10642       | 7990       | ECT                    | 7959      | 0.4        | 0.01                      | 331                        |
|          | 2  | 11004       | 10763       | 8948        | 10734       | 8119       | ECT                    | 8119      | 0.0        | 0.02                      | 289                        |
|          | 3  | 14123       | 13352       | 11018       | 13334       | 10054      | ECT                    | 10042     | 0.1        | 0.01                      | 206                        |
|          | 4  | 9598        | 10729       | 8675        | 9629        | 7790       | ECT                    | 7790      | 0.0        | 0.01                      | 250                        |
|          | 5  | 10968       | 12510       | 8918        | 10019       | 8097       | ECT                    | 8042      | 0.7        | 0.02                      | 372                        |
|          | 6  | 11777       | 11676       | 9569        | 11361       | 8632       | ECT                    | 8632      | 0.0        | 0.02                      | 351                        |
|          | 7  | 69643       | 71802       | 71389       | 67597       | 66433      | ECT                    | 64816     | 2.5        | 0.01                      | 754                        |
|          | 8  | 68121       | 72885       | 71347       | 69846       | 65843      | ECT                    | 64567     | 2.0        | 0.01                      | 1232                       |
|          | 9  | 70151       | 71231       | 71999       | 69149       | 66268      | ECT                    | 65563     | 1.1        | 0.02                      | 857                        |
|          | 10 | 75644       | 76240       | 74021       | 71605       | 69380      | ECT                    | 68233     | 1.7        | 0.01                      | 590                        |
|          | 11 | 72504       | 73586       | 72490       | 70322       | 68002      | ECT                    | 66595     | 2.1        | 0.01                      | 1544                       |
|          | 12 | 71884       | 76348       | 72206       | 72045       | 68437      | ECT                    | 67589     | 1.3        | 0.02                      | 1298                       |
|          | 13 | 30595       | 33001       | 31515       | 29670       | 28361      | ECT                    | 27704     | 2.4        | 0.01                      | 455                        |
|          | 14 | 35954       | 43155       | 39163       | 33651       | 34266      | SPTL                   | 31818     | 5.8        | 0.01                      | 634                        |
|          | 15 | 34828       | 37622       | 34169       | 31877       | 31056      | ECT                    | 29662     | 4.7        | 0.02                      | 727                        |
|          | 16 | 32524       | 37727       | 35799       | 30473       | 28754      | ECT                    | 27965     | 2.8        | 0.02                      | 741                        |
|          | 17 | 38368       | 42450       | 39301       | 35881       | 33634      | ECT                    | 32781     | 2.6        | 0.01                      | 1122                       |
|          | 18 | 29712       | 33939       | 31918       | 26889       | 26227      | ECT                    | 25006     | 4.9        | 0.01                      | 491                        |
|          | 19 | 30278       | 32278       | 31843       | 29020       | 28153      | ECT                    | 27223     | 3.4        | 0.01                      | 953                        |
|          | 20 | 42371       | 45842       | 41950       | 37667       | 36945      | ECT                    | 35470     | 4.2        | 0.02                      | 440                        |
|          | 21 | 32972       | 39687       | 36665       | 31653       | 30539      | ECT                    | 29438     | 3.7        | 0.02                      | 456                        |
|          | 22 | 31623       | 39491       | 34427       | 29616       | 29668      | SPTL                   | 28307     | 4.6        | 0.02                      | 474                        |
|          | 23 | 31442       | 38024       | 35232       | 30246       | 28769      | ECT                    | 27849     | 3.3        | 0.01                      | 1191                       |
|          | 24 | 36353       | 44126       | 41191       | 35139       | 34092      | ECT                    | 33067     | 3.1        | 0.01                      | 435                        |
|          | 25 | 37727       | 43079       | 39031       | 35718       | 32971      | ECT                    | 31930     | 3.3        | 0.01                      | 568                        |
|          | 26 | 37370       | 39778       | 40642       | 35659       | 33384      | ECT                    | 33115     | 0.8        | 0.01                      | 826                        |
|          | 27 | 39232       | 43520       | 40840       | 36497       | 34979      | ECT                    | 34124     | 2.5        | 0.02                      | 448                        |
|          | 28 | 34981       | 38952       | 38915       | 33878       | 33577      | ECT                    | 32474     | 3.4        | 0.02                      | 493                        |
|          | 29 | 43619       | 48720       | 43675       | 40344       | 38932      | ECT                    | 38080     | 2.2        | 0.02                      | 686                        |
|          | 30 | 33549       | 36387       | 36092       | 32293       | 30809      | ECT                    | 30366     | 1.5        | 0.02                      | 604                        |

Table V. Comparative overview of performance of heuristics for  $\sum C_j : n = 100; m = 2, 5$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 2        | 1  | 201751      | 213174      | 207565      | 203246      | 200816     | ECT                    | 195018    | 3.0        | 0.01                      | 1562                       |
|          | 2  | 205999      | 213855      | 210832      | 209122      | 206147     | STPT                   | 200783    | 2.6        | 0.01                      | 1557                       |
|          | 3  | 204499      | 205327      | 203993      | 205021      | 199803     | ECT                    | 196457    | 1.7        | 0.01                      | 1712                       |
|          | 4  | 191028      | 194739      | 194380      | 195040      | 190711     | ECT                    | 185350    | 2.9        | 0.01                      | 1939                       |
|          | 5  | 182448      | 190810      | 189360      | 192013      | 184299     | STPT                   | 179656    | 1.6        | 0.01                      | 1026                       |
|          | 6  | 180926      | 183442      | 182534      | 181679      | 177799     | ECT                    | 173788    | 2.3        | 0.01                      | 2046                       |
|          | 7  | 216187      | 222412      | 221924      | 213943      | 209152     | ECT                    | 206370    | 1.3        | 0.01                      | 1237                       |
|          | 8  | 195894      | 201311      | 200536      | 199321      | 196490     | STPT                   | 192888    | 1.6        | 0.01                      | 1527                       |
|          | 9  | 200508      | 206189      | 205088      | 201764      | 200954     | STPT                   | 196381    | 2.1        | 0.01                      | 1072                       |
|          | 10 | 221545      | 231421      | 221801      | 214317      | 209866     | ECT                    | 205013    | 2.4        | 0.01                      | 1514                       |
|          | 11 | 206242      | 220136      | 216598      | 209408      | 208566     | STPT                   | 201386    | 2.4        | 0.01                      | 1021                       |
|          | 12 | 213643      | 223749      | 223769      | 217551      | 216280     | STPT                   | 211158    | 1.2        | 0.01                      | 1020                       |
|          | 13 | 157153      | 165991      | 158212      | 149317      | 147830     | ECT                    | 143631    | 2.9        | 0.01                      | 1519                       |
|          | 14 | 166179      | 173796      | 163558      | 160290      | 157854     | ECT                    | 151896    | 3.9        | 0.01                      | 1107                       |
|          | 15 | 174370      | 180235      | 171737      | 165156      | 164223     | ECT                    | 159978    | 2.7        | 0.01                      | 1593                       |
|          | 16 | 157171      | 156214      | 152659      | 154897      | 149392     | ECT                    | 144814    | 3.2        | 0.01                      | 1123                       |
|          | 17 | 153210      | 162478      | 156608      | 153016      | 153534     | SPTL                   | 147269    | 3.9        | 0.01                      | 997                        |
|          | 18 | 128037      | 136491      | 134150      | 132959      | 129660     | STPT                   | 125277    | 2.2        | 0.01                      | 978                        |
|          | 19 | 139517      | 150046      | 148639      | 142968      | 139635     | STPT                   | 135975    | 2.6        | 0.01                      | 1018                       |
|          | 20 | 141024      | 143590      | 142133      | 139021      | 135478     | ECT                    | 132144    | 2.5        | 0.01                      | 1104                       |
|          | 21 | 130790      | 133171      | 131435      | 129222      | 128839     | ECT                    | 125085    | 3.0        | 0.00                      | 1113                       |
|          | 22 | 145814      | 146745      | 143823      | 142601      | 138710     | ECT                    | 136054    | 2.0        | 0.01                      | 1158                       |
|          | 23 | 141637      | 149349      | 145730      | 148807      | 142014     | STPT                   | 136834    | 3.5        | 0.01                      | 1920                       |
|          | 24 | 158325      | 161330      | 158544      | 155472      | 153393     | ECT                    | 148104    | 3.6        | 0.01                      | 1116                       |
|          | 25 | 148989      | 158511      | 154313      | 150759      | 149599     | STPT                   | 144107    | 3.4        | 0.01                      | 985                        |
|          | 26 | 165388      | 175426      | 172032      | 164535      | 161683     | ECT                    | 157099    | 2.9        | 0.01                      | 1393                       |
|          | 27 | 139780      | 144985      | 141154      | 145174      | 138983     | ECT                    | 134754    | 3.1        | 0.01                      | 1038                       |
|          | 28 | 149989      | 156720      | 156538      | 151103      | 150989     | STPT                   | 145229    | 3.3        | 0.01                      | 1001                       |
|          | 29 | 139542      | 142974      | 134355      | 130506      | 127037     | ECT                    | 123435    | 2.9        | 0.01                      | 1034                       |
|          | 30 | 163311      | 167103      | 160520      | 156075      | 153293     | ECT                    | 149279    | 2.7        | 0.01                      | 1743                       |
| 5        | 1  | 103994      | 110052      | 99651       | 97515       | 93032      | ECT                    | 91273     | 1.9        | 0.02                      | 2577                       |
|          | 2  | 94761       | 99806       | 89461       | 85230       | 82581      | ECT                    | 80964     | 2.0        | 0.01                      | 2172                       |
|          | 3  | 93280       | 94335       | 87444       | 87790       | 82232      | ECT                    | 81222     | 1.2        | 0.02                      | 3498                       |
|          | 4  | 109957      | 106437      | 100354      | 96899       | 90966      | ECT                    | 90072     | 1.0        | 0.01                      | 2087                       |
|          | 5  | 82072       | 84702       | 81806       | 76945       | 74836      | ECT                    | 73965     | 1.2        | 0.01                      | 4243                       |
|          | 6  | 98101       | 100491      | 96893       | 93273       | 90403      | ECT                    | 88234     | 2.5        | 0.02                      | 2979                       |
|          | 7  | 249554      | 259712      | 252916      | 240689      | 233617     | ECT                    | 228520    | 2.2        | 0.01                      | 4605                       |
|          | 8  | 242514      | 259491      | 254702      | 238001      | 233039     | ECT                    | 227198    | 2.6        | 0.01                      | 7113                       |
|          | 9  | 250124      | 250693      | 246399      | 246944      | 234599     | ECT                    | 229900    | 2.0        | 0.01                      | 4966                       |
|          | 10 | 245050      | 249357      | 248271      | 241748      | 234259     | ECT                    | 230343    | 1.7        | 0.01                      | 2665                       |
|          | 11 | 243903      | 254265      | 250479      | 243098      | 233447     | ECT                    | 229776    | 1.6        | 0.02                      | 2872                       |
|          | 12 | 239113      | 249683      | 251398      | 238742      | 228734     | ECT                    | 225028    | 1.6        | 0.01                      | 6686                       |
|          | 13 | 151015      | 156628      | 153760      | 141097      | 137223     | ECT                    | 133429    | 2.8        | 0.01                      | 1910                       |
|          | 14 | 128104      | 139369      | 134581      | 120749      | 117735     | ECT                    | 113583    | 3.7        | 0.02                      | 4424                       |
|          | 15 | 118352      | 121990      | 117253      | 110751      | 106863     | ECT                    | 103077    | 3.7        | 0.01                      | 2934                       |
|          | 16 | 114464      | 125841      | 119278      | 114066      | 108994     | ECT                    | 105267    | 3.5        | 0.01                      | 2392                       |
|          | 17 | 122977      | 128874      | 125311      | 116855      | 114927     | ECT                    | 111761    | 2.8        | 0.01                      | 3768                       |
|          | 18 | 133698      | 151235      | 148460      | 131324      | 129739     | ECT                    | 124916    | 3.9        | 0.02                      | 2780                       |
|          | 19 | 141270      | 145670      | 141035      | 131423      | 129141     | ECT                    | 123707    | 4.4        | 0.01                      | 1929                       |
|          | 20 | 112450      | 123473      | 113304      | 105222      | 100120     | ECT                    | 98671     | 1.5        | 0.01                      | 2166                       |
|          | 21 | 122470      | 126192      | 117291      | 108660      | 107856     | ECT                    | 103522    | 4.2        | 0.02                      | 3365                       |
|          | 22 | 134124      | 143796      | 139599      | 120486      | 121740     | SPTL                   | 116780    | 3.2        | 0.02                      | 1649                       |
|          | 23 | 129769      | 141243      | 132100      | 122887      | 120911     | ECT                    | 117557    | 2.9        | 0.01                      | 2397                       |
|          | 24 | 115955      | 129537      | 122726      | 111038      | 111203     | SPTL                   | 105216    | 5.5        | 0.01                      | 4970                       |
|          | 25 | 133180      | 143945      | 138104      | 123345      | 122986     | ECT                    | 118212    | 4.0        | 0.02                      | 2979                       |
|          | 26 | 122546      | 137444      | 131057      | 118425      | 117392     | ECT                    | 113179    | 3.7        | 0.02                      | 2302                       |
|          | 27 | 129092      | 141098      | 128155      | 113314      | 113220     | ECT                    | 108600    | 4.3        | 0.01                      | 2230                       |
|          | 28 | 143415      | 156544      | 155445      | 135081      | 135905     | SPTL                   | 129778    | 4.1        | 0.01                      | 2590                       |
|          | 29 | 131370      | 142748      | 135913      | 123166      | 123013     | ECT                    | 116774    | 5.3        | 0.01                      | 2521                       |
|          | 30 | 123541      | 140041      | 134739      | 119482      | 117665     | ECT                    | 114058    | 3.2        | 0.01                      | 2072                       |

Table VI. Comparative overview of performance of heuristics for  $\sum C_j : n = 100; m = 10, 20$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 10       | 1  | 51730       | 51400       | 44439       | 48755       | 40797      | ECT                    | 40737     | 0.1        | 0.02                      | 2636                       |
|          | 2  | 58215       | 62199       | 53409       | 52941       | 47774      | ECT                    | 47772     | 0.0        | 0.02                      | 2790                       |
|          | 3  | 75948       | 72560       | 54272       | 57862       | 49362      | ECT                    | 49308     | 0.1        | 0.02                      | 3120                       |
|          | 4  | 61968       | 64749       | 51435       | 57161       | 48159      | ECT                    | 48017     | 0.3        | 0.02                      | 2851                       |
|          | 5  | 60656       | 67568       | 56693       | 55732       | 49312      | ECT                    | 49206     | 0.2        | 0.02                      | 7364                       |
|          | 6  | 54978       | 54301       | 44912       | 52371       | 42233      | ECT                    | 42211     | 0.1        | 0.02                      | 3275                       |
|          | 7  | 276864      | 282550      | 275075      | 263835      | 252802     | ECT                    | 249672    | 1.3        | 0.02                      | 4210                       |
|          | 8  | 257167      | 270210      | 263083      | 254641      | 244296     | ECT                    | 240482    | 1.6        | 0.01                      | 6524                       |
|          | 9  | 259098      | 268138      | 264762      | 257705      | 244024     | ECT                    | 242521    | 0.6        | 0.01                      | 3851                       |
|          | 10 | 260479      | 275763      | 265342      | 253495      | 245523     | ECT                    | 241963    | 1.5        | 0.02                      | 4346                       |
|          | 11 | 259891      | 269720      | 268469      | 257727      | 247510     | ECT                    | 243847    | 1.5        | 0.02                      | 8386                       |
|          | 12 | 267753      | 283469      | 277726      | 265789      | 256535     | ECT                    | 252102    | 1.8        | 0.02                      | 13291                      |
|          | 13 | 103451      | 117310      | 112632      | 98146       | 94447      | ECT                    | 92113     | 2.5        | 0.02                      | 2913                       |
|          | 14 | 123965      | 135866      | 124446      | 110146      | 107764     | ECT                    | 104830    | 2.8        | 0.02                      | 2231                       |
|          | 15 | 109043      | 123944      | 120151      | 104311      | 103188     | ECT                    | 100297    | 2.9        | 0.02                      | 3220                       |
|          | 16 | 112129      | 121801      | 112808      | 104669      | 100711     | ECT                    | 98938     | 1.8        | 0.02                      | 4969                       |
|          | 17 | 123672      | 138739      | 131214      | 114723      | 113004     | ECT                    | 108668    | 4.0        | 0.02                      | 6086                       |
|          | 18 | 128959      | 136254      | 128690      | 113144      | 105832     | ECT                    | 103901    | 1.9        | 0.02                      | 2538                       |
|          | 19 | 143618      | 155772      | 146089      | 129021      | 125409     | ECT                    | 122594    | 2.3        | 0.02                      | 3729                       |
|          | 20 | 134627      | 140335      | 139964      | 124791      | 121124     | ECT                    | 117117    | 3.4        | 0.02                      | 2442                       |
|          | 21 | 134335      | 148495      | 143211      | 124231      | 123752     | ECT                    | 119466    | 3.6        | 0.02                      | 4839                       |
|          | 22 | 148186      | 159584      | 152570      | 130367      | 128325     | ECT                    | 123734    | 3.7        | 0.02                      | 5597                       |
|          | 23 | 130243      | 142621      | 134454      | 118771      | 117489     | ECT                    | 113190    | 3.8        | 0.02                      | 2609                       |
|          | 24 | 115493      | 129718      | 117632      | 105188      | 101477     | ECT                    | 99313     | 2.2        | 0.02                      | 2606                       |
|          | 25 | 122796      | 135949      | 131373      | 113624      | 109419     | ECT                    | 105929    | 3.3        | 0.02                      | 7596                       |
|          | 26 | 121208      | 126884      | 126167      | 112220      | 109858     | ECT                    | 106125    | 3.5        | 0.02                      | 2317                       |
|          | 27 | 132947      | 147615      | 141208      | 122825      | 118801     | ECT                    | 116182    | 2.3        | 0.02                      | 3536                       |
|          | 28 | 133057      | 153166      | 147027      | 123765      | 122887     | ECT                    | 117968    | 4.2        | 0.02                      | 4448                       |
|          | 29 | 107358      | 126239      | 123233      | 102094      | 100368     | ECT                    | 97256     | 3.2        | 0.02                      | 2523                       |
|          | 30 | 109784      | 109965      | 110470      | 100395      | 97980      | ECT                    | 94984     | 3.2        | 0.02                      | 3115                       |
| 20       | 1  | 31507       | 34709       | 27525       | 30990       | 24747      | ECT                    | 24747     | 0.0        | 0.03                      | 6391                       |
|          | 2  | 51461       | 46619       | 35878       | 42608       | 31491      | ECT                    | 31477     | 0.0        | 0.03                      | 2847                       |
|          | 3  | 32125       | 32806       | 29098       | 31060       | 25387      | ECT                    | 25382     | 0.0        | 0.03                      | 3132                       |
|          | 4  | 37878       | 36863       | 32590       | 36348       | 28273      | ECT                    | 28273     | 0.0        | 0.03                      | 4022                       |
|          | 5  | 34968       | 33774       | 28264       | 32763       | 25172      | ECT                    | 25166     | 0.0        | 0.03                      | 7097                       |
|          | 6  | 40499       | 44293       | 31757       | 38119       | 28112      | ECT                    | 28094     | 0.1        | 0.03                      | 3972                       |
|          | 7  | 289001      | 293160      | 285506      | 274469      | 262438     | ECT                    | 260394    | 0.8        | 0.03                      | 6526                       |
|          | 8  | 273900      | 283547      | 275002      | 269019      | 258144     | ECT                    | 256525    | 0.6        | 0.03                      | 8440                       |
|          | 9  | 274384      | 284745      | 281724      | 271487      | 262668     | ECT                    | 258037    | 1.8        | 0.03                      | 19790                      |
|          | 10 | 267783      | 272543      | 268307      | 263080      | 252054     | ECT                    | 248345    | 1.5        | 0.03                      | 10674                      |
|          | 11 | 261362      | 269259      | 268743      | 255660      | 249175     | ECT                    | 245036    | 1.7        | 0.03                      | 17883                      |
|          | 12 | 267170      | 279653      | 273371      | 261601      | 255429     | ECT                    | 252458    | 1.2        | 0.02                      | 11975                      |
|          | 13 | 110099      | 129673      | 124382      | 105393      | 99857      | ECT                    | 97284     | 2.6        | 0.03                      | 4876                       |
|          | 14 | 113829      | 136348      | 118819      | 105227      | 99864      | ECT                    | 98280     | 1.6        | 0.03                      | 14629                      |
|          | 15 | 137730      | 156302      | 151811      | 127682      | 125522     | ECT                    | 122560    | 2.4        | 0.03                      | 5754                       |
|          | 16 | 137083      | 151313      | 147545      | 127781      | 123397     | ECT                    | 120796    | 2.2        | 0.03                      | 6812                       |
|          | 17 | 110439      | 134767      | 126446      | 106747      | 103577     | ECT                    | 100953    | 2.6        | 0.03                      | 6907                       |
|          | 18 | 127908      | 141958      | 134976      | 115439      | 109811     | ECT                    | 108266    | 1.4        | 0.03                      | 10421                      |
|          | 19 | 132345      | 143943      | 135258      | 119921      | 114191     | ECT                    | 110852    | 3.0        | 0.02                      | 9334                       |
|          | 20 | 120176      | 145148      | 134570      | 113565      | 109159     | ECT                    | 107385    | 1.7        | 0.03                      | 4868                       |
|          | 21 | 116835      | 125242      | 126888      | 108913      | 104216     | ECT                    | 103149    | 1.0        | 0.03                      | 5298                       |
|          | 22 | 119721      | 135257      | 128844      | 110862      | 104187     | ECT                    | 102891    | 1.3        | 0.02                      | 7974                       |
|          | 23 | 127583      | 143185      | 137284      | 115073      | 110980     | ECT                    | 109126    | 1.7        | 0.03                      | 5193                       |
|          | 24 | 120266      | 135267      | 134017      | 116405      | 110744     | ECT                    | 107821    | 2.7        | 0.03                      | 19503                      |
|          | 25 | 107071      | 122575      | 115705      | 99753       | 94460      | ECT                    | 93314     | 1.2        | 0.03                      | 5584                       |
|          | 26 | 130740      | 147528      | 150994      | 123489      | 120915     | ECT                    | 117383    | 3.0        | 0.03                      | 4864                       |
|          | 27 | 132380      | 151070      | 144857      | 124730      | 121623     | ECT                    | 117812    | 3.2        | 0.02                      | 5636                       |
|          | 28 | 133653      | 139942      | 134332      | 123943      | 115767     | ECT                    | 111257    | 4.1        | 0.03                      | 8660                       |
|          | 29 | 127697      | 149131      | 127412      | 112500      | 107025     | ECT                    | 105929    | 1.0        | 0.03                      | 7162                       |
|          | 30 | 127584      | 155583      | 148116      | 121953      | 116698     | ECT                    | 114081    | 2.3        | 0.03                      | 10750                      |

Table VII. Comparative overview of performance of heuristics for  $\sum C_j : n = 200; m = 2, 5$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 2        | 1  | 751347      | 783748      | 779718      | 777272      | 763389     | STPT                   | 740643    | 1.4        | 0.03                      | 9039                       |
|          | 2  | 829435      | 854575      | 853640      | 828372      | 815843     | ECT                    | 800122    | 2.0        | 0.02                      | 10024                      |
|          | 3  | 768405      | 782816      | 778434      | 783170      | 768321     | ECT                    | 744624    | 3.2        | 0.02                      | 14159                      |
|          | 4  | 795511      | 808556      | 811992      | 816084      | 796506     | STPT                   | 772984    | 2.9        | 0.03                      | 16922                      |
|          | 5  | 794570      | 822327      | 815773      | 815454      | 805579     | STPT                   | 784393    | 1.3        | 0.02                      | 10488                      |
|          | 6  | 842382      | 865672      | 856989      | 842777      | 830685     | ECT                    | 807824    | 2.8        | 0.03                      | 20416                      |
|          | 7  | 843822      | 856501      | 848258      | 836643      | 828090     | ECT                    | 808598    | 2.4        | 0.02                      | 14519                      |
|          | 8  | 837933      | 858716      | 840240      | 833960      | 821696     | ECT                    | 802098    | 2.4        | 0.03                      | 9623                       |
|          | 9  | 818484      | 830768      | 831279      | 817138      | 801141     | ECT                    | 785153    | 2.0        | 0.03                      | 9341                       |
|          | 10 | 821884      | 849591      | 846073      | 835875      | 831064     | STPT                   | 807313    | 1.8        | 0.03                      | 13372                      |
|          | 11 | 825740      | 845863      | 832096      | 827147      | 811036     | ECT                    | 792398    | 2.4        | 0.02                      | 18337                      |
|          | 12 | 816934      | 852053      | 842047      | 829034      | 827049     | STPT                   | 798687    | 2.3        | 0.03                      | 8550                       |
|          | 13 | 524535      | 549043      | 540464      | 537407      | 532650     | STPT                   | 512362    | 2.4        | 0.03                      | 7778                       |
|          | 14 | 597476      | 621466      | 610716      | 603040      | 593563     | ECT                    | 569578    | 4.2        | 0.02                      | 10304                      |
|          | 15 | 569398      | 599351      | 591598      | 593068      | 580237     | STPT                   | 555122    | 2.6        | 0.03                      | 8155                       |
|          | 16 | 576178      | 598529      | 582215      | 585182      | 569821     | ECT                    | 550376    | 3.5        | 0.03                      | 8235                       |
|          | 17 | 581322      | 617125      | 606928      | 590374      | 586522     | STPT                   | 560592    | 3.7        | 0.03                      | 8172                       |
|          | 18 | 631182      | 632364      | 599318      | 574009      | 570848     | ECT                    | 559548    | 2.0        | 0.02                      | 10899                      |
|          | 19 | 540160      | 561198      | 544520      | 537284      | 531893     | ECT                    | 512133    | 3.9        | 0.03                      | 9236                       |
|          | 20 | 536433      | 556059      | 542984      | 542576      | 532878     | ECT                    | 513987    | 3.7        | 0.03                      | 8019                       |
|          | 21 | 465829      | 485368      | 481019      | 482458      | 469719     | STPT                   | 456290    | 2.1        | 0.03                      | 7833                       |
|          | 22 | 564995      | 591358      | 576411      | 567375      | 565601     | STPT                   | 542035    | 4.2        | 0.02                      | 8608                       |
|          | 23 | 536922      | 571798      | 550490      | 536515      | 529926     | ECT                    | 508640    | 4.2        | 0.03                      | 9401                       |
|          | 24 | 549608      | 588418      | 561030      | 543699      | 529878     | ECT                    | 512792    | 3.3        | 0.03                      | 9611                       |
|          | 25 | 580357      | 611249      | 594751      | 581161      | 565406     | ECT                    | 550480    | 2.7        | 0.03                      | 8224                       |
|          | 26 | 591139      | 617955      | 605809      | 595336      | 586403     | ECT                    | 564890    | 3.8        | 0.02                      | 8247                       |
|          | 27 | 527452      | 547236      | 530931      | 546358      | 518392     | ECT                    | 499358    | 3.8        | 0.02                      | 8236                       |
|          | 28 | 524515      | 534706      | 528454      | 534962      | 515166     | ECT                    | 503053    | 2.4        | 0.02                      | 9529                       |
|          | 29 | 581755      | 617815      | 603057      | 578097      | 584974     | SPTL                   | 558522    | 3.5        | 0.02                      | 9393                       |
|          | 30 | 571783      | 607625      | 592904      | 575297      | 564737     | ECT                    | 540480    | 4.5        | 0.02                      | 8378                       |
| 5        | 1  | 371409      | 387267      | 364436      | 347015      | 340158     | ECT                    | 333817    | 1.9        | 0.04                      | 19231                      |
|          | 2  | 364931      | 394215      | 349997      | 334870      | 330505     | ECT                    | 323557    | 2.1        | 0.04                      | 13158                      |
|          | 3  | 380434      | 390428      | 360494      | 344328      | 338138     | ECT                    | 333884    | 1.3        | 0.04                      | 17198                      |
|          | 4  | 384166      | 388334      | 364814      | 352035      | 344302     | ECT                    | 337819    | 1.9        | 0.04                      | 11451                      |
|          | 5  | 406444      | 420561      | 379426      | 362291      | 348197     | ECT                    | 339536    | 2.6        | 0.03                      | 19162                      |
|          | 6  | 399254      | 412515      | 370736      | 362558      | 345531     | ECT                    | 339335    | 1.8        | 0.03                      | 10615                      |
|          | 7  | 979165      | 1011189     | 1010951     | 984742      | 939740     | ECT                    | 924589    | 1.6        | 0.03                      | 16872                      |
|          | 8  | 931835      | 993234      | 980901      | 926650      | 893182     | ECT                    | 873905    | 2.2        | 0.03                      | 25568                      |
|          | 9  | 987612      | 1010520     | 988983      | 950505      | 918844     | ECT                    | 896552    | 2.5        | 0.03                      | 37098                      |
|          | 10 | 939733      | 977652      | 957589      | 943436      | 904757     | ECT                    | 889579    | 1.7        | 0.04                      | 29036                      |
|          | 11 | 938173      | 1004099     | 994097      | 953533      | 930099     | ECT                    | 908780    | 2.3        | 0.03                      | 14904                      |
|          | 12 | 991293      | 1012317     | 993323      | 950901      | 920978     | ECT                    | 907160    | 1.5        | 0.03                      | 25014                      |
|          | 13 | 486650      | 521557      | 490995      | 441174      | 441986     | SPTL                   | 421258    | 4.7        | 0.04                      | 9633                       |
|          | 14 | 454887      | 505987      | 486880      | 434019      | 434275     | SPTL                   | 413464    | 5.0        | 0.04                      | 8742                       |
|          | 15 | 516277      | 557034      | 536091      | 481149      | 482783     | SPTL                   | 461344    | 4.3        | 0.03                      | 13554                      |
|          | 16 | 417998      | 463566      | 448585      | 402387      | 402663     | SPTL                   | 384162    | 4.7        | 0.03                      | 9900                       |
|          | 17 | 491101      | 543844      | 521061      | 457016      | 462205     | SPTL                   | 440006    | 3.9        | 0.03                      | 12801                      |
|          | 18 | 556129      | 621752      | 589021      | 521635      | 524978     | SPTL                   | 497944    | 4.8        | 0.03                      | 12951                      |
|          | 19 | 439837      | 473619      | 467456      | 409579      | 413778     | SPTL                   | 390019    | 5.0        | 0.04                      | 9100                       |
|          | 20 | 394058      | 448084      | 443564      | 387700      | 391943     | SPTL                   | 373971    | 3.7        | 0.04                      | 13760                      |
|          | 21 | 440190      | 485695      | 474575      | 418905      | 421295     | SPTL                   | 403212    | 3.9        | 0.04                      | 12710                      |
|          | 22 | 523662      | 566825      | 543375      | 492751      | 484907     | ECT                    | 471785    | 2.8        | 0.04                      | 13153                      |
|          | 23 | 463979      | 503138      | 482871      | 440062      | 438458     | ECT                    | 419693    | 4.5        | 0.04                      | 18271                      |
|          | 24 | 488739      | 542436      | 519433      | 469309      | 462833     | ECT                    | 445767    | 3.8        | 0.04                      | 13992                      |
|          | 25 | 458310      | 521344      | 494502      | 434739      | 444621     | SPTL                   | 418990    | 3.8        | 0.03                      | 16491                      |
|          | 26 | 473525      | 541779      | 515238      | 445493      | 454376     | SPTL                   | 431600    | 3.2        | 0.03                      | 12957                      |
|          | 27 | 428752      | 487710      | 466674      | 412079      | 416598     | SPTL                   | 400603    | 2.9        | 0.03                      | 10831                      |
|          | 28 | 540924      | 581511      | 536442      | 482758      | 479520     | ECT                    | 464309    | 3.3        | 0.03                      | 12109                      |
|          | 29 | 428606      | 495622      | 467657      | 418544      | 422376     | SPTL                   | 404091    | 3.6        | 0.04                      | 12810                      |
|          | 30 | 455252      | 514794      | 481892      | 431880      | 438531     | SPTL                   | 415521    | 3.9        | 0.04                      | 16107                      |

Table VIII. Comparative overview of performance of heuristics for  $\sum C_j : n = 200; m = 10, 20$ 

| <i>m</i> | #  | <i>STPT</i> | <i>SMPT</i> | <i>SMCT</i> | <i>SPTL</i> | <i>ECT</i> | <i>H<sub>min</sub></i> | <i>TS</i> | <i>Imp</i> | <i>T<sub>h</sub>(Sec)</i> | <i>T<sub>ts</sub>(Sec)</i> |
|----------|----|-------------|-------------|-------------|-------------|------------|------------------------|-----------|------------|---------------------------|----------------------------|
| 10       | 1  | 237466      | 252118      | 193219      | 194552      | 177337     | ECT                    | 177115    | 0.1        | 0.05                      | 11201                      |
|          | 2  | 209844      | 210412      | 189056      | 196525      | 171373     | ECT                    | 171286    | 0.1        | 0.05                      | 14426                      |
|          | 3  | 199665      | 203585      | 181484      | 185055      | 164176     | ECT                    | 163615    | 0.3        | 0.05                      | 27724                      |
|          | 4  | 187374      | 191601      | 178248      | 176727      | 160612     | ECT                    | 160612    | 0.0        | 0.05                      | 17901                      |
|          | 5  | 205714      | 202787      | 183809      | 188188      | 167676     | ECT                    | 167676    | 0.0        | 0.05                      | 20128                      |
|          | 6  | 235584      | 232684      | 198005      | 204483      | 182980     | ECT                    | 182980    | 0.0        | 0.05                      | 24718                      |
|          | 7  | 1001510     | 1054578     | 1044552     | 999337      | 969660     | ECT                    | 952735    | 1.8        | 0.04                      | 38809                      |
|          | 8  | 1004234     | 1060654     | 1035245     | 1004700     | 965507     | ECT                    | 951801    | 1.4        | 0.05                      | 53767                      |
|          | 9  | 1009360     | 1065229     | 1052366     | 989070      | 965537     | ECT                    | 950044    | 1.6        | 0.05                      | 32679                      |
|          | 10 | 1028652     | 1092001     | 1069718     | 1012878     | 986717     | ECT                    | 975016    | 1.2        | 0.04                      | 37607                      |
|          | 11 | 1013691     | 1059720     | 1036856     | 1013642     | 967850     | ECT                    | 955816    | 1.3        | 0.04                      | 53849                      |
|          | 12 | 966551      | 1043540     | 1025245     | 971817      | 939464     | ECT                    | 926601    | 1.4        | 0.05                      | 25654                      |
|          | 13 | 432196      | 514772      | 486009      | 409766      | 405781     | ECT                    | 396874    | 2.2        | 0.05                      | 15840                      |
|          | 14 | 445836      | 511796      | 499376      | 422411      | 414488     | ECT                    | 401328    | 3.3        | 0.05                      | 31829                      |
|          | 15 | 501818      | 563292      | 545586      | 466918      | 462835     | ECT                    | 447521    | 3.4        | 0.05                      | 20877                      |
|          | 16 | 496843      | 556241      | 514362      | 449573      | 444749     | ECT                    | 435310    | 2.2        | 0.05                      | 23783                      |
|          | 17 | 443639      | 505098      | 496368      | 420812      | 419896     | ECT                    | 403999    | 3.9        | 0.05                      | 33041                      |
|          | 18 | 424354      | 485555      | 468443      | 403186      | 404185     | SPTL                   | 387939    | 3.9        | 0.05                      | 30047                      |
|          | 19 | 462215      | 525206      | 505369      | 442377      | 436809     | ECT                    | 426006    | 2.5        | 0.05                      | 20468                      |
|          | 20 | 430282      | 498522      | 467904      | 403306      | 396221     | ECT                    | 384520    | 3.0        | 0.04                      | 33976                      |
|          | 21 | 430870      | 469812      | 447524      | 403985      | 390384     | ECT                    | 383033    | 1.9        | 0.05                      | 17944                      |
|          | 22 | 409306      | 467463      | 458183      | 385421      | 378707     | ECT                    | 371715    | 1.9        | 0.05                      | 18682                      |
|          | 23 | 457875      | 508879      | 482532      | 426599      | 409242     | ECT                    | 399485    | 2.4        | 0.05                      | 21013                      |
|          | 24 | 460078      | 489723      | 481575      | 418095      | 406688     | ECT                    | 396200    | 2.6        | 0.05                      | 26122                      |
|          | 25 | 425734      | 488920      | 467073      | 401898      | 393922     | ECT                    | 384122    | 2.6        | 0.05                      | 27370                      |
|          | 26 | 467291      | 520761      | 490647      | 427564      | 421776     | ECT                    | 410260    | 2.8        | 0.05                      | 19501                      |
|          | 27 | 444648      | 505667      | 478840      | 416005      | 408335     | ECT                    | 401643    | 1.7        | 0.04                      | 17608                      |
|          | 28 | 442567      | 506098      | 489526      | 411344      | 410833     | ECT                    | 397857    | 3.3        | 0.05                      | 26183                      |
|          | 29 | 514729      | 592078      | 564618      | 487345      | 482476     | ECT                    | 471690    | 2.3        | 0.05                      | 17268                      |
|          | 30 | 428779      | 500557      | 481875      | 414425      | 411424     | ECT                    | 396966    | 3.6        | 0.05                      | 25527                      |
| 20       | 1  | 124477      | 125115      | 103892      | 117520      | 91383      | ECT                    | 91383     | 0.0        | 0.08                      | 19609                      |
|          | 2  | 124245      | 120029      | 104187      | 114153      | 90937      | ECT                    | 90937     | 0.0        | 0.08                      | 10598                      |
|          | 3  | 139246      | 138588      | 117410      | 133359      | 101366     | ECT                    | 101366    | 0.0        | 0.08                      | 18463                      |
|          | 4  | 142961      | 137936      | 114813      | 130181      | 99859      | ECT                    | 99859     | 0.0        | 0.08                      | 23749                      |
|          | 5  | 117184      | 115943      | 98580       | 105452      | 87375      | ECT                    | 87375     | 0.0        | 0.08                      | 10709                      |
|          | 6  | 118391      | 126743      | 103768      | 114724      | 90801      | ECT                    | 90723     | 0.1        | 0.31                      | 71259                      |
|          | 7  | 1043204     | 1112618     | 1091234     | 1027525     | 994221     | ECT                    | 984208    | 1.0        | 0.07                      | 58318                      |
|          | 8  | 1050091     | 1079484     | 1074355     | 1039653     | 1002311    | ECT                    | 994160    | 0.8        | 0.07                      | 57028                      |
|          | 9  | 1018101     | 1064884     | 1055257     | 1020095     | 983185     | ECT                    | 974861    | 0.9        | 0.07                      | 74136                      |
|          | 10 | 1054917     | 1097954     | 1061766     | 1030505     | 988659     | ECT                    | 985036    | 0.4        | 0.07                      | 33636                      |
|          | 11 | 1009557     | 1082353     | 1057005     | 1007310     | 980984     | ECT                    | 973127    | 0.8        | 0.07                      | 67100                      |
|          | 12 | 1052401     | 1116565     | 1088463     | 1035568     | 1012069    | ECT                    | 1001611   | 1.0        | 0.07                      | 59941                      |
|          | 13 | 418231      | 495028      | 488889      | 400110      | 393625     | ECT                    | 384994    | 2.2        | 0.07                      | 29548                      |
|          | 14 | 472314      | 515464      | 491113      | 436585      | 423977     | ECT                    | 415846    | 2.0        | 0.07                      | 24688                      |
|          | 15 | 536724      | 623068      | 566308      | 489435      | 470414     | ECT                    | 464730    | 1.2        | 0.07                      | 36949                      |
|          | 16 | 450619      | 511593      | 494448      | 431282      | 418664     | ECT                    | 408352    | 2.5        | 0.07                      | 62997                      |
|          | 17 | 424093      | 527320      | 496181      | 406218      | 393643     | ECT                    | 387013    | 1.7        | 0.07                      | 61406                      |
|          | 18 | 462096      | 506016      | 493850      | 423612      | 407513     | ECT                    | 402501    | 1.2        | 0.08                      | 39983                      |
|          | 19 | 434712      | 520330      | 491568      | 419980      | 409574     | ECT                    | 402754    | 1.7        | 0.08                      | 53691                      |
|          | 20 | 420095      | 498411      | 475054      | 401200      | 388663     | ECT                    | 382046    | 1.7        | 0.08                      | 32616                      |
|          | 21 | 423987      | 488693      | 469739      | 400226      | 384071     | ECT                    | 377221    | 1.8        | 0.08                      | 30898                      |
|          | 22 | 443209      | 522240      | 504893      | 424467      | 415818     | ECT                    | 408354    | 1.8        | 0.08                      | 43604                      |
|          | 23 | 440845      | 503560      | 482871      | 420220      | 407102     | ECT                    | 398894    | 2.1        | 0.08                      | 41930                      |
|          | 24 | 469837      | 535533      | 518640      | 437886      | 419401     | ECT                    | 408859    | 2.6        | 0.08                      | 58420                      |
|          | 25 | 417422      | 506891      | 470564      | 403772      | 388220     | ECT                    | 382673    | 1.4        | 0.07                      | 71862                      |
|          | 26 | 503378      | 537893      | 527312      | 461392      | 444382     | ECT                    | 435438    | 2.1        | 0.07                      | 32846                      |
|          | 27 | 446719      | 523702      | 500742      | 422720      | 406579     | ECT                    | 400297    | 1.6        | 0.07                      | 27337                      |
|          | 28 | 496992      | 522920      | 503781      | 442683      | 432434     | ECT                    | 425862    | 1.5        | 0.07                      | 26981                      |
|          | 29 | 417753      | 505517      | 481878      | 400137      | 389781     | ECT                    | 382463    | 1.9        | 0.07                      | 43395                      |
|          | 30 | 477827      | 529550      | 496833      | 429560      | 414017     | ECT                    | 407827    | 1.5        | 0.07                      | 53948                      |

