# parameter test

For $\beta = (1.5, 2, 3, 0(5))$ For lasso,

```
result_case1$lasso_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 lasso_lambda_est
## 1        3     0     4    1     7.461792e-05
## 2        3     0     1    4     5.849751e-03
## 3        3     0     4    1     2.917188e-04
## 4        3     0     3    2     1.135981e-03
## 5        3     0     3    2     5.983321e-04
## 6        3     0     4    1     7.009984e-04
## 7        3     0     4    1     3.607739e-04
## 8        3     0     5    0     8.607866e-05
## 9        3     0     0    5     1.168487e-03
## 10       3     0     2    3     9.341151e-04
## 11       3     0     5    0     1.200946e-04
## 12       3     0     5    0     1.613384e-04
## 13       3     0     3    2     3.275033e-04
## 14       3     0     3    2     7.412974e-04
## 15       3     0     5    0     4.733471e-05
## 16       3     0     5    0     3.802774e-05
## 17       3     0     3    2     1.283908e-03
## 18       3     0     5    0     1.672443e-04
## 19       3     0     2    3     6.594416e-04
## 20       3     0     5    0     2.869719e-05
## 21       3     0     5    0     7.825506e-05
## 22       3     0     5    0     1.342887e-04
## 23       3     0     1    4     3.247570e-03
## 24       3     0     2    3     4.784839e-04
## 25       3     0     3    2     6.393262e-04
## 26       3     0     2    3     2.336581e-03
## 27       3     0     4    1     7.615024e-05
## 28       3     0     5    0     1.388084e-04
## 29       3     0     5    0     2.712155e-04
## 30       3     0     3    2     5.611906e-03
## 31       3     0     2    3     2.570981e-03
## 32       3     0     4    1     2.649388e-04
## 33       3     0     5    0     8.816991e-05
## 34       3     0     4    1     3.937568e-04
## 35       3     0     4    1     2.946958e-04
## 36       3     0     3    2     6.592630e-04
## 37       3     0     4    1     1.438452e-04
## 38       3     0     1    4     5.049393e-03
## 39       3     0     1    4     1.258992e-03
## 40       3     0     2    3     1.146411e-03
## 41       3     0     3    2     6.624006e-04
## 42       3     0     5    0     3.021351e-05
## 43       3     0     2    3     6.531898e-04
## 44       3     0     5    0     1.755115e-04
## 45       3     0     2    3     4.019448e-04
```

```
## 46      3     0     4     1     1.177541e-04
## 47      3     0     5     0     8.040486e-04
## 48      3     0     3     2     3.578941e-04
## 49      3     0     5     0     2.804661e-04
## 50      3     0     4     1     2.328131e-04
## 51      3     0     4     1     4.327225e-04
## 52      3     0     4     1     8.374592e-04
## 53      3     0     0     5     1.002870e-02
## 54      3     0     0     5     5.257105e-03
## 55      3     0     0     5     7.295269e-03
## 56      3     0     2     3     7.578397e-04
## 57      3     0     4     1     2.495235e-04
## 58      3     0     4     1     5.834047e-04
## 59      3     0     4     1     5.092217e-04
## 60      3     0     0     5     5.674174e-03
## 61      3     0     4     1     3.620608e-04
## 62      3     0     4     1     2.286201e-04
## 63      3     0     0     5     1.809557e-03
## 64      3     0     4     1     3.800513e-04
## 65      3     0     4     1     2.258763e-04
## 66      3     0     0     5     1.895226e-03
## 67      3     0     0     5     4.938757e-03
## 68      3     0     1     4     5.068785e-03
## 69      3     0     3     2     8.794911e-04
## 70      3     0     3     2     6.333215e-04
## 71      3     0     3     2     1.000738e-03
## 72      3     0     3     2     3.674708e-04
## 73      3     0     4     1     6.611244e-04
## 74      3     0     0     5     2.253683e-03
## 75      3     0     1     4     2.028932e-03
## 76      3     0     5     0     2.279981e-04
## 77      3     0     2     3     9.948414e-04
## 78      3     0     5     0     3.150790e-05
## 79      3     0     5     0     5.169927e-04
## 80      3     0     5     0     8.602752e-05
## 81      3     0     4     1     1.194922e-04
## 82      3     0     2     3     1.100984e-03
## 83      3     0     1     4     3.836318e-03
## 84      3     0     5     0     2.932703e-04
## 85      3     0     4     1     1.206487e-03
## 86      3     0     2     3     2.286149e-03
## 87      3     0     4     1     1.544868e-04
## 88      3     0     2     3     1.130727e-03
## 89      3     0     4     1     2.867696e-04
## 90      3     0     4     1     6.926721e-04
## 91      3     0     4     1     4.575925e-04
## 92      3     0     0     5     2.381829e-03
## 93      3     0     5     0     8.718447e-05
## 94      3     0     4     1     2.567649e-04
## 95      3     0     3     2     1.737776e-04
## 96      3     0     1     4     2.257478e-03
## 97      3     0     0     5     1.401685e-03
## 98      3     0     4     1     2.630286e-04
## 99      3     0     4     1     3.153587e-04
```

```
## 100      3     0     5    0     2.991798e-05
```

The mean is

```
result_case1$lasso_mean
```

```
##           tn0en0            tn0e0            t0en0            t0e0
##      3.000000000      0.000000000      3.140000000      1.860000000
## lasso_lambda_est
##      0.001183235
```

For SCAD,

```
result_case1$SCAD_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 SCAD_lambda_est
## 1        3     0     3    2    0.0008189310
## 2        3     0     3    2    0.0007555257
## 3        3     0     0    5    0.0027846247
## 4        3     0     5    0    0.0003896948
## 5        3     0     2    3    0.0004853256
## 6        3     0     4    1    0.0002701319
## 7        3     0     4    1    0.0002666379
## 8        3     0     3    2    0.0009017736
## 9        3     0     0    5    0.0034062025
## 10       3     0     2    3    0.0023138746
## 11       3     0     4    1    0.0003583200
## 12       3     0     2    3    0.0007845244
## 13       3     0     2    3    0.0006580305
## 14       3     0     4    1    0.0005229706
## 15       3     0     0    5    0.0032625977
## 16       3     0     3    2    0.0011085288
## 17       3     0     4    1    0.0004508048
## 18       3     0     1    4    0.0016724431
## 19       3     0     3    2    0.0002990498
## 20       3     0     0    5    0.0034566537
## 21       3     0     5    0    0.0002812341
## 22       3     0     4    1    0.0006233198
## 23       3     0     4    1    0.0003733917
## 24       3     0     5    0    0.0002675113
## 25       3     0     3    2    0.0004109636
## 26       3     0     4    1    0.0003551485
## 27       3     0     3    2    0.0005128136
## 28       3     0     1    4    0.0007071094
## 29       3     0     2    3    0.0023046628
## 30       3     0     3    2    0.0005233685
## 31       3     0     1    4    0.0011659088
## 32       3     0     0    5    0.0027755411
## 33       3     0     3    2    0.0010137422
## 34       3     0     4    1    0.0004633778
## 35       3     0     4    1    0.0003016308
## 36       3     0     0    5    0.0019670082
## 37       3     0     2    3    0.0005807056
## 38       3     0     5    0    0.0002758119
## 39       3     0     2    3    0.0004219642
## 40       3     0     3    2    0.0003932744
## 41       3     0     2    3    0.0006471720
## 42       3     0     1    4    0.0007840507
## 43       3     0     0    5    0.0018175396
## 44       3     0     5    0    0.0003067113
## 45       3     0     2    3    0.0011716994
## 46       3     0     3    2    0.0004980105
## 47       3     0     5    0    0.0002572366
## 48       3     0     2    3    0.0008077765
## 49       3     0     5    0    0.0003150543
```

```
## 50      3     0     1     4    0.0025551209
## 51      3     0     4     1    0.0002655146
## 52      3     0     5     0    0.0003303112
## 53      3     0     4     1    0.0006012048
## 54      3     0     3     2    0.0009186942
## 55      3     0     0     5    0.0027466237
## 56      3     0     4     1    0.0002853224
## 57      3     0     0     5    0.0043604943
## 58      3     0     4     1    0.0005834047
## 59      3     0     1     4    0.0024192389
## 60      3     0     5     0    0.0005170098
## 61      3     0     4     1    0.0007107408
## 62      3     0     4     1    0.0005041375
## 63      3     0     0     5    0.0028813265
## 64      3     0     1     4    0.0007460562
## 65      3     0     4     1    0.0003056226
## 66      3     0     4     1    0.0002624672
## 67      3     0     1     4    0.0007683106
## 68      3     0     1     4    0.0009066419
## 69      3     0     2     3    0.0006061993
## 70      3     0     0     5    0.0026785047
## 71      3     0     1     4    0.0010007377
## 72      3     0     2     3    0.0008893266
## 73      3     0     3     2    0.0011028291
## 74      3     0     1     4    0.0007379796
## 75      3     0     1     4    0.0009201009
## 76      3     0     5     0    0.0002444750
## 77      3     0     2     3    0.0008856228
## 78      3     0     5     0    0.0002615841
## 79      3     0     5     0    0.0008623964
## 80      3     0     5     0    0.0003020591
## 81      3     0     3     2    0.0006680658
## 82      3     0     0     5    0.0046563886
## 83      3     0     2     3    0.0005968068
## 84      3     0     4     1    0.0007972812
## 85      3     0     5     0    0.0002660477
## 86      3     0     4     1    0.0002628515
## 87      3     0     0     5    0.0030326403
## 88      3     0     2     3    0.0005895618
## 89      3     0     2     3    0.0003004279
## 90      3     0     4     1    0.0004350183
## 91      3     0     3     2    0.0007286175
## 92      3     0     1     4    0.0008967438
## 93      3     0     2     3    0.0009133583
## 94      3     0     0     5    0.0027532059
## 95      3     0     3     2    0.0007699439
## 96      3     0     2     3    0.0005723547
## 97      3     0     0     5    0.0012191238
## 98      3     0     4     1    0.0002755529
## 99      3     0     3     2    0.0003979376
## 100     3     0     0     5    0.0010263300
```

The mean is

```
result_case1$SCAD_mean
```

```
##          tn0en0           tn0e0           t0en0           t0e0
##     3.000000000     0.000000000     2.580000000     2.420000000
## SCAD_lambda_est
##     0.001016087
```

For MCP,

```
result_case1$MCP_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 MCP_lambda_est
## 1        3     0     2    3   0.0010096164
## 2        3     0     4    1   0.0004635836
## 3        3     0     0    5   0.0036811099
## 4        3     0     5    0   0.0003896948
## 5        3     0     2    3   0.0005580065
## 6        3     0     4    1   0.0002701319
## 7        3     0     4    1   0.0003287237
## 8        3     0     2    3   0.0014696663
## 9        3     0     0    5   0.0041993256
## 10       3     0     1    4   0.0028526528
## 11       3     0     4    1   0.0003842147
## 12       3     0     1    4   0.0012785794
## 13       3     0     2    3   0.0008698776
## 14       3     0     5    0   0.0002602837
## 15       3     0     0    5   0.0040222830
## 16       3     0     5    0   0.0002388253
## 17       3     0     4    1   0.0006390041
## 18       3     0     1    4   0.0019229031
## 19       3     0     3    2   0.0003953262
## 20       3     0     1    4   0.0010556121
## 21       3     0     5    0   0.0003233509
## 22       3     0     4    1   0.0010158560
## 23       3     0     2    3   0.0006085355
## 24       3     0     5    0   0.0002675113
## 25       3     0     3    2   0.0004406628
## 26       3     0     4    1   0.0005034139
## 27       3     0     4    1   0.0002736732
## 28       3     0     1    4   0.0007582102
## 29       3     0     2    3   0.0028412960
## 30       3     0     2    3   0.0006918624
## 31       3     0     1    4   0.0016526456
## 32       3     0     0    5   0.0034218169
## 33       3     0     3    2   0.0010137422
## 34       3     0     4    1   0.0005712739
## 35       3     0     4    1   0.0003718645
## 36       3     0     0    5   0.0015955010
## 37       3     0     2    3   0.0007159210
## 38       3     0     5    0   0.0006371612
## 39       3     0     2    3   0.0010452375
## 40       3     0     0    5   0.0019573361
## 41       3     0     2    3   0.0007978639
## 42       3     0     1    4   0.0011916874
## 43       3     0     0    5   0.0031762020
## 44       3     0     5    0   0.0004661739
## 45       3     0     2    3   0.0014445257
## 46       3     0     3    2   0.0006583406
## 47       3     0     5    0   0.0002572366
## 48       3     0     2    3   0.0009287467
## 49       3     0     5    0   0.0002740181
```

```
## 50      3     0     1     4   0.0029377681
## 51      3     0     4     1   0.0003273388
## 52      3     0     5     0   0.0005383249
## 53      3     0     5     0   0.0002602472
## 54      3     0     4     1   0.0002616474
## 55      3     0     0     5   0.0031579499
## 56      3     0     4     1   0.0002660926
## 57      3     0     1     4   0.0028689141
## 58      3     0     3     2   0.0011721960
## 59      3     0     0     5   0.0034292087
## 60      3     0     5     0   0.0005944356
## 61      3     0     4     1   0.0007107408
## 62      3     0     3     2   0.0008809946
## 63      3     0     0     5   0.0035522340
## 64      3     0     1     4   0.0022783480
## 65      3     0     4     1   0.0003056226
## 66      3     0     4     1   0.0003235819
## 67      3     0     4     1   0.0002697686
## 68      3     0     1     4   0.0010424179
## 69      3     0     2     3   0.0007473508
## 70      3     0     0     5   0.0043652953
## 71      3     0     1     4   0.0010007377
## 72      3     0     1     4   0.0015541235
## 73      3     0     3     2   0.0012679855
## 74      3     0     0     5   0.0022536829
## 75      3     0     1     4   0.0011343434
## 76      3     0     5     0   0.0003715803
## 77      3     0     2     3   0.0008856228
## 78      3     0     5     0   0.0002615841
## 79      3     0     5     0   0.0011400373
## 80      3     0     4     1   0.0003472946
## 81      3     0     3     2   0.0008236228
## 82      3     0     0     5   0.0061554717
## 83      3     0     1     4   0.0010429368
## 84      3     0     5     0   0.0002799407
## 85      3     0     5     0   0.0002660477
## 86      3     0     1     4   0.0012200488
## 87      3     0     0     5   0.0034867994
## 88      3     0     1     4   0.0006778528
## 89      3     0     2     3   0.0003454191
## 90      3     0     4     1   0.0005750685
## 91      3     0     3     2   0.0006795112
## 92      3     0     1     4   0.0010310374
## 93      3     0     5     0   0.0002601277
## 94      3     0     0     5   0.0033942809
## 95      3     0     3     2   0.0008852483
## 96      3     0     2     3   0.0006580688
## 97      3     0     0     5   0.0014016962
## 98      3     0     2     3   0.0011124119
## 99      3     0     3     2   0.0004266954
## 100     3     0     0     5   0.0012653076
```

The mean is

```
result_case1$MCP_mean
```

```
##         tn0en0          tn0e0          t0en0          t0e0 MCP_lambda_est
##    3.000000000    0.000000000    2.510000000    2.490000000    0.001226862
```

For $\beta = (1.5, 2, 3, 0(45))$ For lasso,

```
result_case2$lasso_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 lasso_lambda_est
## 1        3     0    37   10     4.911211e-05
## 2        3     0    44    3     3.681805e-05
## 3        3     0    42    5     4.395302e-05
## 4        3     0    41    6     4.752150e-05
## 5        3     0    41    6     5.425173e-05
## 6        3     0    40    7     9.900092e-05
## 7        3     0    40    7     3.269484e-05
## 8        3     0    40    7     3.714861e-05
## 9        3     0    47    0     2.914681e-05
## 10       3     0    37   10     5.207843e-05
## 11       3     0    30   17     2.114588e-04
## 12       3     0    41    6     3.067873e-05
## 13       3     0    46    1     2.796849e-05
## 14       3     0    40    7     3.796665e-05
## 15       3     0    39    8     6.834616e-05
## 16       3     0    45    2     3.908690e-05
## 17       3     0    42    5     9.607766e-05
## 18       3     0    46    1     3.708288e-05
## 19       3     0    47    0     3.243552e-05
## 20       3     0    46    1     2.926649e-05
## 21       3     0    45    2     3.792165e-05
## 22       3     0    41    6     5.931234e-05
## 23       3     0    46    1     3.711517e-05
## 24       3     0    36   11     2.392434e-04
## 25       3     0    40    7     5.084959e-05
## 26       3     0    41    6     4.118650e-05
## 27       3     0    45    2     3.906950e-05
## 28       3     0    37   10     1.320752e-04
## 29       3     0    42    5     3.434133e-05
## 30       3     0    37   10     6.885838e-05
## 31       3     0    43    4     2.867044e-05
## 32       3     0    44    3     5.728657e-05
## 33       3     0    41    6     1.187954e-04
## 34       3     0    43    4     3.052384e-05
## 35       3     0    38    9     9.391760e-05
## 36       3     0    41    6     1.315635e-04
## 37       3     0    47    0     5.271832e-05
## 38       3     0    45    2     2.898584e-05
## 39       3     0    41    6     6.621793e-05
## 40       3     0    44    3     2.942810e-05
## 41       3     0    44    3     4.507293e-05
## 42       3     0    45    2     3.119813e-05
## 43       3     0    47    0     3.303678e-05
## 44       3     0    39    8     5.345003e-05
## 45       3     0    44    3     3.026060e-05
## 46       3     0    40    7     1.055485e-04
## 47       3     0    42    5     5.362909e-05
## 48       3     0    46    1     2.993038e-05
## 49       3     0    44    3     3.979032e-05
```

```
## 50      3     0    42    5     3.095126e-05
## 51      3     0    44    3     2.936309e-05
## 52      3     0    42    5     6.548609e-05
## 53      3     0    41    6     6.118992e-05
## 54      3     0    40    7     3.983666e-05
## 55      3     0    45    2     4.168575e-05
## 56      3     0    40    7     6.287634e-05
## 57      3     0    44    3     5.281315e-05
## 58      3     0    43    4     4.420933e-05
## 59      3     0    35   12     1.293454e-04
## 60      3     0    29   18     2.092017e-04
## 61      3     0    42    5     2.936881e-05
## 62      3     0    47    0     3.299336e-05
## 63      3     0    45    2     7.159388e-05
## 64      3     0    40    7     9.618078e-05
## 65      3     0    43    4     3.248898e-05
## 66      3     0    43    4     5.582191e-05
## 67      3     0    46    1     2.858013e-05
## 68      3     0    40    7     5.310523e-05
## 69      3     0    42    5     5.068646e-05
## 70      3     0    41    6     3.735970e-05
## 71      3     0    45    2     3.007512e-05
## 72      3     0    44    3     4.334771e-05
## 73      3     0    44    3     3.327315e-05
## 74      3     0    38    9     1.636756e-04
## 75      3     0    44    3     3.831891e-05
## 76      3     0    44    3     3.475659e-05
## 77      3     0    41    6     3.274235e-05
## 78      3     0    42    5     6.279387e-05
## 79      3     0    44    3     3.006508e-05
## 80      3     0    41    6     5.124442e-05
## 81      3     0    40    7     7.056940e-05
## 82      3     0    40    7     5.327462e-05
## 83      3     0    45    2     5.038008e-05
## 84      3     0    42    5     3.944278e-05
## 85      3     0    46    1     3.078722e-05
## 86      3     0    40    7     4.532096e-05
## 87      3     0    39    8     1.332346e-04
## 88      3     0    42    5     6.041039e-05
## 89      3     0    44    3     3.994295e-05
## 90      3     0    45    2     2.861328e-05
## 91      3     0    43    4     3.584026e-05
## 92      3     0    44    3     3.149940e-05
## 93      3     0    31   16     1.603544e-04
## 94      3     0    43    4     5.277637e-05
## 95      3     0    37   10     9.781805e-05
## 96      3     0    44    3     3.770702e-05
## 97      3     0    43    4     2.761222e-05
## 98      3     0    47    0     3.500478e-05
## 99      3     0    44    3     3.032058e-05
## 100     3     0    40    7     3.666880e-05
```

The mean is

```
result_case2$lasso_mean
```

```
##           tn0en0            tn0e0            t0en0            t0e0
##       3.0000e+00       0.0000e+00       4.1990e+01       5.0100e+00
## lasso_lambda_est
##       5.7651e-05
```

For SCAD,

```
result_case2$SCAD_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 SCAD_lambda_est
## 1        3     0     9   38    0.0012165444
## 2        3     0     4   43    0.0021068641
## 3        3     0     5   42    0.0025151533
## 4        3     0     0   47    0.0062820622
## 5        3     0     8   39    0.0018183023
## 6        3     0    17   30    0.0008219258
## 7        3     0     2   45    0.0027143831
## 8        3     0     3   44    0.0024441312
## 9        3     0    12   35    0.0009998735
## 10       3     0    11   36    0.0008891626
## 11       3     0     8   39    0.0011822258
## 12       3     0     2   45    0.0025470173
## 13       3     0    14   33    0.0013599984
## 14       3     0     8   39    0.0011594511
## 15       3     0     0   47    0.0069954436
## 16       3     0    12   35    0.0010876316
## 17       3     0     7   40    0.0023799203
## 18       3     0    11   36    0.0022230601
## 19       3     0    14   33    0.0009455152
## 20       3     0     0   47    0.0037799447
## 21       3     0     0   47    0.0028026837
## 22       3     0     1   46    0.0021315748
## 23       3     0    17   30    0.0008574088
## 24       3     0    18   29    0.0006974074
## 25       3     0     2   45    0.0018704410
## 26       3     0    12   35    0.0008470056
## 27       3     0    13   34    0.0013402672
## 28       3     0     6   41    0.0020546627
## 29       3     0     0   47    0.0036823082
## 30       3     0     0   47    0.0024177555
## 31       3     0    11   36    0.0014948794
## 32       3     0    11   36    0.0008311302
## 33       3     0    15   32    0.0010094676
## 34       3     0    10   37    0.0013523965
## 35       3     0    13   34    0.0013946494
## 36       3     0    12   35    0.0017391922
## 37       3     0    21   26    0.0005150655
## 38       3     0     7   40    0.0016977370
## 39       3     0     4   43    0.0024357470
## 40       3     0     8   39    0.0010824772
## 41       3     0    18   29    0.0007518628
## 42       3     0     5   42    0.0019593424
## 43       3     0    17   30    0.0010818056
## 44       3     0     0   47    0.0027868992
## 45       3     0     1   46    0.0043903153
## 46       3     0    14   33    0.0008172245
## 47       3     0     5   42    0.0020666123
## 48       3     0    14   33    0.0007767005
## 49       3     0    11   36    0.0010325738
```

```
## 50      3     0    11   36    0.0008612372
## 51      3     0    12   35    0.0010800861
## 52      3     0    12   35    0.0014780359
## 53      3     0    21   26    0.0007543781
## 54      3     0    13   34    0.0009640986
## 55      3     0     8   39    0.0019804527
## 56      3     0    15   32    0.0006287640
## 57      3     0    10   37    0.0012781462
## 58      3     0     8   39    0.0012887256
## 59      3     0    15   32    0.0011514527
## 60      3     0    14   33    0.0009487041
## 61      3     0    11   36    0.0011583666
## 62      3     0    17   30    0.0011857205
## 63      3     0    13   34    0.0009914946
## 64      3     0    17   30    0.0010555829
## 65      3     0    13   34    0.0010889016
## 66      3     0    18   29    0.0008098804
## 67      3     0    10   37    0.0012960797
## 68      3     0    14   33    0.0010424796
## 69      3     0    18   29    0.0008653966
## 70      3     0     2   45    0.0029606928
## 71      3     0    14   33    0.0009621864
## 72      3     0    14   33    0.0008914510
## 73      3     0    16   31    0.0006381568
## 74      3     0    15   32    0.0014570772
## 75      3     0    10   37    0.0013145207
## 76      3     0     7   40    0.0013085687
## 77      3     0     3   44    0.0023642663
## 78      3     0     6   41    0.0015554559
## 79      3     0    12   35    0.0011059087
## 80      3     0    13   34    0.0011300064
## 81      3     0    11   36    0.0012048706
## 82      3     0     8   39    0.0012024192
## 83      3     0    12   35    0.0010604534
## 84      3     0     0   47    0.0081114571
## 85      3     0    22   25    0.0005256536
## 86      3     0     2   45    0.0016287509
## 87      3     0     0   47    0.0081751488
## 88      3     0     7   40    0.0013955616
## 89      3     0    24   23    0.0007312509
## 90      3     0    14   33    0.0013913498
## 91      3     0    14   33    0.0014136270
## 92      3     0     8   39    0.0017205846
## 93      3     0     8   39    0.0012707808
## 94      3     0    15   32    0.0007837123
## 95      3     0     2   45    0.0028514491
## 96      3     0    16   31    0.0009785175
## 97      3     0     7   40    0.0021882213
## 98      3     0    16   31    0.0014131491
## 99      3     0    20   27    0.0007338020
## 100     3     0    15   32    0.0010443408
```

The mean is

```
result_case2$SCAD_mean
```

```
##          tn0en0           tn0e0           t0en0           t0e0
##     3.000000000     0.000000000    10.160000000    36.840000000
## SCAD_lambda_est
##     0.001708076
```

For MCP,

```
result_case2$MCP_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 MCP_lambda_est
## 1        3     0     5   42   0.0016082001
## 2        3     0     3   44   0.0024223818
## 3        3     0     3   44   0.0033248846
## 4        3     0     0   47   0.0072228449
## 5        3     0     6   41   0.0022416881
## 6        3     0    14   33   0.0010133086
## 7        3     0     1   46   0.0031208809
## 8        3     0     1   46   0.0030132392
## 9        3     0    10   37   0.0012326908
## 10       3     0     6   41   0.0010962012
## 11       3     0     4   43   0.0015628330
## 12       3     0     0   47   0.0033670069
## 13       3     0    12   35   0.0015636677
## 14       3     0     5   42   0.0014294255
## 15       3     0     0   47   0.0092475647
## 16       3     0     8   39   0.0015416897
## 17       3     0     3   44   0.0033734755
## 18       3     0     8   39   0.0029387547
## 19       3     0    14   33   0.0009455152
## 20       3     0     0   47   0.0043460179
## 21       3     0     0   47   0.0034552794
## 22       3     0     1   46   0.0028178165
## 23       3     0    12   35   0.0011334440
## 24       3     0    17   30   0.0008597964
## 25       3     0     2   45   0.0023059671
## 26       3     0     8   39   0.0011196916
## 27       3     0     8   39   0.0017717543
## 28       3     0     5   42   0.0025330842
## 29       3     0     0   47   0.0045397217
## 30       3     0     2   45   0.0019611160
## 31       3     0     6   41   0.0019761426
## 32       3     0    10   37   0.0008911937
## 33       3     0    11   36   0.0014308943
## 34       3     0     7   40   0.0017877886
## 35       3     0     6   41   0.0018436444
## 36       3     0     8   39   0.0019996484
## 37       3     0    15   32   0.0006808863
## 38       3     0     4   43   0.0022443085
## 39       3     0     1   46   0.0030029028
## 40       3     0     5   42   0.0012445858
## 41       3     0    12   35   0.0010657460
## 42       3     0     3   44   0.0025901354
## 43       3     0    12   35   0.0012438135
## 44       3     0     0   47   0.0034358195
## 45       3     0     0   47   0.0054125858
## 46       3     0    10   37   0.0010803227
## 47       3     0     1   46   0.0031410669
## 48       3     0    13   34   0.0008930168
## 49       3     0     8   39   0.0013650018
```

```
## 50      3     0     7   40   0.0009902135
## 51      3     0     7   40   0.0014278103
## 52      3     0     8   39   0.0016993821
## 53      3     0    16   31   0.0008673515
## 54      3     0     9   38   0.0011084791
## 55      3     0     5   42   0.0022770394
## 56      3     0    12   35   0.0007751696
## 57      3     0     6   41   0.0015757583
## 58      3     0     3   44   0.0014817212
## 59      3     0    15   32   0.0010738487
## 60      3     0     9   38   0.0010907792
## 61      3     0     5   42   0.0017606142
## 62      3     0    13   34   0.0013632904
## 63      3     0     8   39   0.0013106976
## 64      3     0    12   35   0.0014962615
## 65      3     0    12   35   0.0013424488
## 66      3     0    15   32   0.0009311656
## 67      3     0     8   39   0.0015978676
## 68      3     0     5   42   0.0013780966
## 69      3     0    17   30   0.0010669014
## 70      3     0     1   46   0.0039138617
## 71      3     0     8   39   0.0012719538
## 72      3     0     9   38   0.0011784457
## 73      3     0    15   32   0.0009045708
## 74      3     0     6   41   0.0022146278
## 75      3     0     7   40   0.0016206026
## 76      3     0     6   41   0.0018548623
## 77      3     0     0   47   0.0029147780
## 78      3     0     3   44   0.0019176387
## 79      3     0     5   42   0.0015675970
## 80      3     0     9   38   0.0013931247
## 81      3     0     7   40   0.0014854208
## 82      3     0     5   42   0.0014823986
## 83      3     0     8   39   0.0014018570
## 84      3     0     0   47   0.0093262045
## 85      3     0    17   30   0.0006948831
## 86      3     0     2   45   0.0017464562
## 87      3     0     0   47   0.0100787056
## 88      3     0     5   42   0.0017205136
## 89      3     0    20   27   0.0009015203
## 90      3     0     8   39   0.0017153210
## 91      3     0    10   37   0.0016253275
## 92      3     0     6   41   0.0019782542
## 93      3     0     6   41   0.0013626166
## 94      3     0    15   32   0.0008403491
## 95      3     0     5   42   0.0018760631
## 96      3     0    10   37   0.0012063621
## 97      3     0     5   42   0.0028926998
## 98      3     0    16   31   0.0015152735
## 99      3     0    19   28   0.0006843462
## 100     3     0    12   35   0.0012875121
```

The mean is

```
result_case2$MCP_mean
```

```
##         tn0en0          tn0e0          t0en0          t0e0 MCP_lambda_est
##    3.000000000    0.000000000    7.270000000   39.730000000    0.002096285
```

For $\beta = (300, 400, 500, 0(45))$ For lasso,

```
result_case3$lasso_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 lasso_lambda_est
## 1        3     0    14   33     9.961060e-05
## 2        3     0    19   28     3.165310e-05
## 3        3     0    18   29     6.861204e-05
## 4        3     0    16   31     5.340214e-05
## 5        3     0    19   28     2.967068e-05
## 6        3     0    18   29     3.642958e-05
## 7        3     0    27   20     5.186461e-05
## 8        3     0    13   34     3.458542e-05
## 9        3     0    23   24     3.478129e-05
## 10       3     0    21   26     5.092589e-05
## 11       3     0    17   30     3.900561e-05
## 12       3     0    18   29     3.471473e-05
## 13       3     0    15   32     6.119382e-05
## 14       3     0    17   30     6.080883e-05
## 15       3     0     5   42     2.718835e-04
## 16       3     0    13   34     2.791389e-05
## 17       3     0    10   37     2.279088e-04
## 18       3     0    15   32     3.674291e-05
## 19       3     0    10   37     4.068264e-05
## 20       3     0    17   30     4.802647e-05
## 21       3     0     3   44     2.423411e-04
## 22       3     0    15   32     7.392658e-05
## 23       3     0     5   42     1.455708e-04
## 24       3     0     2   45     1.161524e-04
## 25       3     0    30   17     2.652092e-05
## 26       3     0    24   23     3.035192e-05
## 27       3     0    19   28     7.458676e-05
## 28       3     0    20   27     4.288564e-05
## 29       3     0    16   31     3.271565e-05
## 30       3     0    25   22     3.425840e-05
## 31       3     0    20   27     2.853754e-05
## 32       3     0    21   26     3.455761e-05
## 33       3     0    14   33     1.079665e-04
## 34       3     0     3   44     4.741405e-04
## 35       3     0    15   32     3.268684e-05
## 36       3     0    15   32     3.312277e-05
## 37       3     0    17   30     3.521196e-05
## 38       3     0    19   28     3.814976e-05
## 39       3     0    26   21     2.907452e-05
## 40       3     0     6   41     6.933823e-05
## 41       3     0     9   38     6.839617e-05
## 42       3     0    14   33     3.487950e-05
## 43       3     0    24   23     2.883189e-05
## 44       3     0    17   30     4.604377e-05
## 45       3     0    11   36     3.014290e-05
## 46       3     0    13   34     5.557593e-05
## 47       3     0    17   30     3.834771e-05
## 48       3     0     9   38     2.099321e-04
## 49       3     0    21   26     4.357048e-05
```

```
## 50      3     0    14   33     3.799157e-05
## 51      3     0    27   20     3.247385e-05
## 52      3     0    17   30     9.103350e-05
## 53      3     0    23   24     3.561135e-05
## 54      3     0     5   42     1.531431e-04
## 55      3     0    17   30     4.997019e-05
## 56      3     0    14   33     1.109339e-04
## 57      3     0    16   31     2.938781e-05
## 58      3     0    22   25     3.024864e-05
## 59      3     0    17   30     5.931587e-05
## 60      3     0    23   24     2.989318e-05
## 61      3     0     7   40     9.943631e-05
## 62      3     0    19   28     5.364857e-05
## 63      3     0    17   30     5.444889e-05
## 64      3     0    25   22     2.812511e-05
## 65      3     0    14   33     1.102703e-04
## 66      3     0     1   46     1.889633e-03
## 67      3     0    16   31     4.954593e-05
## 68      3     0    20   27     3.812305e-05
## 69      3     0    25   22     3.213157e-05
## 70      3     0    21   26     3.148823e-05
## 71      3     0    15   32     1.111294e-04
## 72      3     0    17   30     5.520899e-05
## 73      3     0     5   42     2.310114e-04
## 74      3     0    26   21     2.775276e-05
## 75      3     0    23   24     2.850430e-05
## 76      3     0    19   28     4.038232e-05
## 77      3     0    15   32     1.052774e-04
## 78      3     0    14   33     1.681089e-04
## 79      3     0    19   28     3.518554e-05
## 80      3     0    21   26     2.791570e-05
## 81      3     0    13   34     4.395074e-05
## 82      3     0    17   30     5.238045e-05
## 83      3     0    15   32     8.603223e-05
## 84      3     0    16   31     5.584653e-05
## 85      3     0    23   24     3.081423e-05
## 86      3     0    21   26     3.813124e-05
## 87      3     0    15   32     8.101085e-05
## 88      3     0    15   32     1.709731e-04
## 89      3     0    19   28     3.579148e-05
## 90      3     0    12   35     7.939555e-05
## 91      3     0    13   34     4.982749e-05
## 92      3     0    23   24     7.118932e-05
## 93      3     0    23   24     3.098163e-05
## 94      3     0    21   26     3.727539e-05
## 95      3     0    15   32     5.145122e-05
## 96      3     0     2   45     3.452477e-04
## 97      3     0    14   33     6.339336e-05
## 98      3     0    20   27     2.842984e-05
## 99      3     0    19   28     6.817468e-05
## 100     3     0    22   25     2.908437e-05
```

The mean is

```
result_case3$lasso_mean
```

```
##           tn0en0            tn0e0            t0en0            t0e0
##     3.000000e+00     0.000000e+00     1.647000e+01     3.053000e+01
## lasso_lambda_est
##     8.924945e-05
```

For SCAD,

```
result_case3$SCAD_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 SCAD_lambda_est
## 1        3     0     0   47     0.004413418
## 2        3     0     0   47     0.005280068
## 3        3     0     0   47     0.003336332
## 4        3     0     0   47     0.004865808
## 5        3     0     0   47     0.006245432
## 6        3     0     0   47     0.002396824
## 7        3     0     0   47     0.003109211
## 8        3     0     0   47     0.004902394
## 9        3     0     0   47     0.002342224
## 10       3     0     0   47     0.002476323
## 11       3     0     0   47     0.005792277
## 12       3     0     0   47     0.002506685
## 13       3     0     0   47     0.003501736
## 14       3     0     0   47     0.004000816
## 15       3     0     0   47     0.002364704
## 16       3     0     0   47     0.007767206
## 17       3     0     0   47     0.002501317
## 18       3     0     0   47     0.003347877
## 19       3     0     0   47     0.003974743
## 20       3     0     0   47     0.003159821
## 21       3     0     0   47     0.004541042
## 22       3     0     0   47     0.004978332
## 23       3     0     0   47     0.003136236
## 24       3     0     0   47     0.002811036
## 25       3     0     0   47     0.007209946
## 26       3     0     0   47     0.002897238
## 27       3     0     0   47     0.005774982
## 28       3     0     0   47     0.007153756
## 29       3     0     0   47     0.003348548
## 30       3     0     0   47     0.002307013
## 31       3     0     0   47     0.003437358
## 32       3     0     0   47     0.004675884
## 33       3     0     0   47     0.002867689
## 34       3     0     0   47     0.002650831
## 35       3     0     0   47     0.002360261
## 36       3     0     0   47     0.002391733
## 37       3     0     0   47     0.003521209
## 38       3     0     0   47     0.002691390
## 39       3     0     0   47     0.003045893
## 40       3     0     0   47     0.003144405
## 41       3     0     0   47     0.002697688
## 42       3     0     0   47     0.002348841
## 43       3     0     0   47     0.003238787
## 44       3     0     0   47     0.002345535
## 45       3     0     0   47     0.002561403
## 46       3     0     0   47     0.005304992
## 47       3     0     0   47     0.002643164
## 48       3     0     0   47     0.007722257
## 49       3     0     0   47     0.002379940
```

```
## 50      3     0     0   47     0.002618618
## 51      3     0     0   47     0.006085006
## 52      3     0     0   47     0.005331974
## 53      3     0     0   47     0.003170177
## 54      3     0     0   47     0.002803649
## 55      3     0     0   47     0.006453899
## 56      3     0     0   47     0.003387762
## 57      3     0     0   47     0.003539773
## 58      3     0     0   47     0.002570392
## 59      3     0     0   47     0.002628062
## 60      3     0     0   47     0.002723755
## 61      3     0     0   47     0.004724045
## 62      3     0     0   47     0.003142208
## 63      3     0     0   47     0.002773703
## 64      3     0     0   47     0.003895117
## 65      3     0     0   47     0.002547415
## 66      3     0     0   47     0.003459430
## 67      3     0     0   47     0.003661810
## 68      3     0     0   47     0.002883869
## 69      3     0     0   47     0.002927710
## 70      3     0     0   47     0.004260537
## 71      3     0     0   47     0.003393750
## 72      3     0     0   47     0.003086651
## 73      3     0     0   47     0.004430613
## 74      3     0     0   47     0.003045861
## 75      3     0     0   47     0.003201963
## 76      3     0     0   47     0.002984545
## 77      3     0     0   47     0.004557211
## 78      3     0     0   47     0.002496364
## 79      3     0     0   47     0.004651333
## 80      3     0     0   47     0.003605465
## 81      3     0     0   47     0.005946745
## 82      3     0     0   47     0.002547055
## 83      3     0     0   47     0.004183410
## 84      3     0     0   47     0.003507325
## 85      3     0     0   47     0.002277397
## 86      3     0     0   47     0.002339698
## 87      3     0     0   47     0.003760193
## 88      3     0     0   47     0.003279177
## 89      3     0     0   47     0.002525018
## 90      3     0     0   47     0.006905537
## 91      3     0     0   47     0.003515242
## 92      3     0     0   47     0.003154136
## 93      3     0     0   47     0.004001455
## 94      3     0     0   47     0.003242023
## 95      3     0     0   47     0.007125410
## 96      3     0     0   47     0.006936870
## 97      3     0     0   47     0.007288696
## 98      3     0     0   47     0.002253016
## 99      3     0     0   47     0.003554658
## 100     3     0     0   47     0.003046997
```

The mean is

```
result_case3$SCAD_mean
```

```
##          tn0en0           tn0e0           t0en0            t0e0
##     3.000000000     0.000000000     0.000000000    47.000000000
## SCAD_lambda_est
##     0.003769053
```

For MCP,

```
result_case3$MCP_result
```

```
##     tn0en0 tn0e0 t0en0 t0e0 MCP_lambda_est
## 1        3     0     0   47    0.005441068
## 2        3     0     0   47    0.006509515
## 3        3     0     0   47    0.004410434
## 4        3     0     0   47    0.005998795
## 5        3     0     0   47    0.007699661
## 6        3     0     0   47    0.002954917
## 7        3     0     0   47    0.004110194
## 8        3     0     0   47    0.006043900
## 9        3     0     0   47    0.002887604
## 10       3     0     0   47    0.003273554
## 11       3     0     0   47    0.007657049
## 12       3     0     0   47    0.003090358
## 13       3     0     0   47    0.004317103
## 14       3     0     0   47    0.004599966
## 15       3     0     0   47    0.002915318
## 16       3     0     0   47    0.010267789
## 17       3     0     0   47    0.003083740
## 18       3     0     0   47    0.004127420
## 19       3     0     0   47    0.004900249
## 20       3     0     0   47    0.003895575
## 21       3     0     0   47    0.006002990
## 22       3     0     0   47    0.006137520
## 23       3     0     0   47    0.003605909
## 24       3     0     0   47    0.003465577
## 25       3     0     0   47    0.008888759
## 26       3     0     0   47    0.003571850
## 27       3     0     0   47    0.007119668
## 28       3     0     0   47    0.009456844
## 29       3     0     0   47    0.004426584
## 30       3     0     0   47    0.002844194
## 31       3     0     0   47    0.004237736
## 32       3     0     0   47    0.005764648
## 33       3     0     0   47    0.003535421
## 34       3     0     0   47    0.003504242
## 35       3     0     0   47    0.003120125
## 36       3     0     0   47    0.003161730
## 37       3     0     0   47    0.004654831
## 38       3     0     0   47    0.003557860
## 39       3     0     0   47    0.003755119
## 40       3     0     0   47    0.003876569
## 41       3     0     0   47    0.003325836
## 42       3     0     0   47    0.002895761
## 43       3     0     0   47    0.003992928
## 44       3     0     0   47    0.002891685
## 45       3     0     0   47    0.003157818
## 46       3     0     0   47    0.006099451
## 47       3     0     0   47    0.003258617
## 48       3     0     0   47    0.009520359
## 49       3     0     0   47    0.002934102
```

```
## 50      3     0     0   47    0.003228355
## 51      3     0     0   47    0.008044020
## 52      3     0     0   47    0.006573507
## 53      3     0     0   47    0.003908342
## 54      3     0     0   47    0.003456469
## 55      3     0     0   47    0.007956668
## 56      3     0     0   47    0.004478421
## 57      3     0     0   47    0.004363997
## 58      3     0     0   47    0.003397907
## 59      3     0     0   47    0.003474143
## 60      3     0     0   47    0.003600644
## 61      3     0     0   47    0.005431503
## 62      3     0     0   47    0.003873861
## 63      3     0     0   47    0.003419551
## 64      3     0     0   47    0.004802082
## 65      3     0     0   47    0.003140572
## 66      3     0     0   47    0.004264947
## 67      3     0     0   47    0.004840698
## 68      3     0     0   47    0.003812305
## 69      3     0     0   47    0.003609417
## 70      3     0     0   47    0.005252589
## 71      3     0     0   47    0.003901988
## 72      3     0     0   47    0.003805368
## 73      3     0     0   47    0.005857010
## 74      3     0     0   47    0.003755080
## 75      3     0     0   47    0.004538701
## 76      3     0     0   47    0.003679487
## 77      3     0     0   47    0.006024364
## 78      3     0     0   47    0.003077634
## 79      3     0     0   47    0.005347903
## 80      3     0     0   47    0.004444986
## 81      3     0     0   47    0.007861247
## 82      3     0     0   47    0.003367057
## 83      3     0     0   47    0.005157503
## 84      3     0     0   47    0.004323994
## 85      3     0     0   47    0.003010585
## 86      3     0     0   47    0.002884489
## 87      3     0     0   47    0.004635742
## 88      3     0     0   47    0.004334879
## 89      3     0     0   47    0.003112960
## 90      3     0     0   47    0.008513469
## 91      3     0     0   47    0.004646943
## 92      3     0     0   47    0.003888566
## 93      3     0     0   47    0.004933180
## 94      3     0     0   47    0.004285764
## 95      3     0     0   47    0.008784538
## 96      3     0     0   47    0.008552098
## 97      3     0     0   47    0.008985845
## 98      3     0     0   47    0.002978355
## 99      3     0     0   47    0.004699049
## 100     3     0     0   47    0.004319040
```

The mean is

```
result_case3$MCP_mean
```

```
##         tn0en0          tn0e0          t0en0          t0e0 MCP_lambda_est
##    3.000000000    0.000000000    0.000000000   47.000000000    0.004735868
```