

# A Simheuristic Approach to Optimize Energy Consumption in the Single-Machine Scheduling Problem with Stochastic Processing Times

Matheus Lopes Bittencourt<sup>a</sup>, Clarissa Maria Rodrigues de Oliveira<sup>a</sup>, Isis Didier Lins<sup>a,b</sup>, Raphael Kramer<sup>a</sup>

<sup>a</sup>*Graduate Program in Production Engineering, Federal University of Pernambuco, Av. da Arquitetura, Cidade Universitária, 50740-550, Recife, Brazil*

<sup>b</sup>*Center of Studies and Testing in Risk and Environmental Modeling*

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## Abstract

This paper addresses a stochastic single-machine scheduling problem with energy consumption. In this problem, job processing times are random variables, and total energy consumption depends on job scheduling, as each job has its own energy use and each period follows a Time-Of-Use tariff policy. To solve the problem, we propose a simheuristic algorithm that combines the metaheuristics Simulated Annealing and Greedy Randomized Adaptive Search Procedure to explore the solution space, along with Monte Carlo Simulation to better evaluate the solutions during the search. The solutions obtained are compared with those derived from a deterministic approach, and the results show that the simheuristic outperforms the deterministic method in terms of Average, Value at Risk, and Conditional Value at Risk, emphasizing the importance of incorporating uncertainty into the solution methods.

*Keywords:* Green Scheduling, Time-Of-use, Stochastic Processing Time.

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## 1. SimSA-Expected X SimExact

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\*Corresponding author

*Email addresses:* `matheus.bittencourt@ufpe.br` (Matheus Lopes Bittencourt), `clarissa.maria@ufpe.br` (Clarissa Maria Rodrigues de Oliveira), `isis.lins@ufpe.br` (Isis Didier Lins), `raphael.kramer@ufpe.br` (Raphael Kramer)

Table 1: Result of SimExact x SimSA-Expected

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|-------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 1    | 25  | 0.1      | 3.83                 | 200.30  | 0.56           | 2.31                 | 8.93  | 354        | 3319       | -39.74%                |
| 2    | 25  | 0.1      | 6.48                 | 187.00  | 0.63           | 2.48                 | 2.36  | 308        | 3297       | -61.80%                |
| 3    | 25  | 0.1      | 4.02                 | 134.10  | 0.67           | 3.98                 | 3.53  | 426        | 3847       | -0.89%                 |
| 4    | 25  | 0.1      | 3.86                 | 374.80  | 0.83           | 3.19                 | 2.86  | 437        | 3773       | -17.35%                |
| 5    | 25  | 0.1      | 2.35                 | 265.40  | 0.29           | 2.13                 | 2.11  | 352        | 3090       | -9.48%                 |
| 6    | 25  | 0.1      | 3.97                 | 228.40  | 0.27           | 3.01                 | 2.23  | 381        | 3276       | -24.32%                |
| 7    | 25  | 0.1      | 6.61                 | 3604.91 | 0.12           | 1.89                 | 2.04  | 364        | 3148       | -71.38%                |
| 8    | 25  | 0.1      | 3.81                 | 381.00  | 0.56           | 2.34                 | 2.15  | 386        | 3246       | -38.62%                |
| 9    | 25  | 0.1      | 3.83                 | 346.40  | 0.50           | 2.42                 | 2.42  | 349        | 3148       | -36.83%                |
| 10   | 25  | 0.1      | 4.42                 | 265.20  | 0.83           | 3.96                 | 3.67  | 415        | 3405       | -10.30%                |
| 11   | 25  | 0.1      | 8.75                 | 366.60  | 0.26           | 2.28                 | 2.92  | 361        | 3367       | -73.93%                |
| 12   | 25  | 0.1      | 8.24                 | 168.70  | 0.44           | 1.80                 | 3.07  | 349        | 3074       | -78.12%                |
| 13   | 25  | 0.1      | 3.95                 | 285.30  | 0.01           | 2.30                 | 1.44  | 348        | 2778       | -41.68%                |
| 14   | 25  | 0.1      | 2.99                 | 342.60  | 0.60           | 2.53                 | 8.03  | 394        | 3652       | -15.23%                |
| 15   | 25  | 0.1      | 2.75                 | 257.20  | 0.15           | 2.41                 | 2.05  | 345        | 2904       | -12.06%                |
| 16   | 25  | 0.1      | 3.68                 | 391.40  | 0.39           | 2.94                 | 2.79  | 365        | 3275       | -20.11%                |
| 17   | 25  | 0.1      | 8.36                 | 243.80  | 0.37           | 2.61                 | 1.99  | 311        | 3017       | -68.76%                |
| 18   | 25  | 0.1      | 2.99                 | 218.00  | 0.35           | 2.35                 | 2.76  | 350        | 3391       | -21.44%                |
| 19   | 25  | 0.1      | 14.16                | 638.00  | 0.24           | 14.02                | 2.13  | 337        | 3165       | -0.95%                 |
| 20   | 25  | 0.1      | 2.70                 | 368.10  | 0.43           | 2.23                 | 1.92  | 333        | 2995       | -17.34%                |
| 21   | 25  | 0.1      | 2.67                 | 3607.43 | 0.45           | 2.39                 | 2.12  | 310        | 2904       | -10.56%                |
| 22   | 25  | 0.1      | 19.77                | 1070.50 | 0.07           | 19.44                | 3.03  | 462        | 4138       | -1.64%                 |
| 23   | 25  | 0.1      | 3.28                 | 318.30  | 0.38           | 1.59                 | 2.25  | 327        | 2887       | -51.63%                |
| 24   | 25  | 0.1      | 7.86                 | 194.20  | 0.47           | 1.97                 | 1.71  | 284        | 2808       | -74.89%                |
| 25   | 25  | 0.1      | 3.15                 | 359.70  | 0.63           | 2.22                 | 2.44  | 334        | 2972       | -29.57%                |
| 26   | 25  | 0.5      | 7.28                 | 342.30  | 0.44           | 6.00                 | 19.31 | 1527       | 14265      | -17.54%                |
| 27   | 25  | 0.5      | 10.78                | 214.00  | 0.76           | 6.76                 | 53.66 | 1738       | 15239      | -37.35%                |
| 28   | 25  | 0.5      | 8.85                 | 240.50  | 0.31           | 8.42                 | 44.55 | 1756       | 16186      | -4.94%                 |
| 29   | 25  | 0.5      | 8.44                 | 458.20  | 0.75           | 6.90                 | 42.91 | 1729       | 14762      | -18.16%                |
| 30   | 25  | 0.5      | 6.61                 | 276.10  | 0.30           | 6.44                 | 35.27 | 1672       | 14129      | -2.53%                 |
| 31   | 25  | 0.5      | 8.26                 | 297.40  | 0.39           | 8.11                 | 41.09 | 1762       | 15963      | -1.78%                 |
| 32   | 25  | 0.5      | 9.56                 | 3617.21 | 0.19           | 5.92                 | 34.53 | 1580       | 14319      | -38.15%                |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |         |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|---------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)    | # $\rho_S$ | # $\rho_L$ |                        |
| 33   | 25  | 0.5      | 8.29                 | 460.90  | 0.72           | 6.31                 | 41.01   | 1605       | 15884      | -23.93%                |
| 34   | 25  | 0.5      | 8.10                 | 432.30  | 0.15           | 6.64                 | 35.80   | 1661       | 14819      | -17.96%                |
| 35   | 25  | 0.5      | 9.30                 | 400.40  | 0.90           | 9.10                 | 48.97   | 1719       | 15262      | -2.18%                 |
| 36   | 25  | 0.5      | 11.46                | 450.80  | 0.33           | 6.32                 | 46.05   | 1744       | 14993      | -44.85%                |
| 37   | 25  | 0.5      | 11.47                | 266.10  | 0.42           | 6.61                 | 32.68   | 1700       | 14827      | -42.37%                |
| 38   | 25  | 0.5      | 8.47                 | 291.30  | 1.25           | 7.29                 | 44.55   | 1635       | 15311      | -13.88%                |
| 39   | 25  | 0.5      | 9.45                 | 432.00  | 1.22           | 8.45                 | 204.10  | 2130       | 19637      | -10.54%                |
| 40   | 25  | 0.5      | 6.84                 | 325.90  | 0.01           | 6.68                 | 30.17   | 1576       | 14480      | -2.35%                 |
| 41   | 25  | 0.5      | 8.72                 | 467.20  | 0.32           | 7.95                 | 50.21   | 1675       | 16068      | -8.76%                 |
| 42   | 25  | 0.5      | 11.80                | 309.70  | 0.49           | 7.20                 | 36.49   | 1572       | 14691      | -38.93%                |
| 43   | 25  | 0.5      | 7.43                 | 252.40  | 0.33           | 7.34                 | 36.27   | 1709       | 15654      | -1.16%                 |
| 44   | 25  | 0.5      | 2.78                 | 243.20  | 0.22           | 2.69                 | 37.64   | 1640       | 15466      | -3.25%                 |
| 45   | 25  | 0.5      | 6.16                 | 380.20  | 0.21           | 5.98                 | 34.94   | 1562       | 14131      | -2.97%                 |
| 46   | 25  | 0.5      | 7.02                 | 3626.84 | 0.02           | 6.91                 | 28.14   | 1559       | 13709      | -1.55%                 |
| 47   | 25  | 0.5      | 4.22                 | 307.60  | 0.06           | 3.33                 | 71.26   | 2265       | 20638      | -21.21%                |
| 48   | 25  | 0.5      | 7.28                 | 415.30  | 0.31           | 6.00                 | 38.47   | 1624       | 14930      | -17.54%                |
| 49   | 25  | 0.5      | 11.52                | 222.50  | 0.47           | 6.71                 | 34.39   | 1693       | 14363      | -41.78%                |
| 50   | 25  | 0.5      | 7.20                 | 367.70  | 0.64           | 6.64                 | 30.15   | 1605       | 14245      | -7.75%                 |
| 51   | 25  | 2.0      | 13.07                | 915.20  | 0.44           | 12.35                | 303.83  | 5326       | 47260      | -5.52%                 |
| 52   | 25  | 2.0      | 16.51                | 791.40  | 0.76           | 14.16                | 588.97  | 5890       | 52549      | -14.23%                |
| 53   | 25  | 2.0      | 14.75                | 441.10  | 0.87           | 14.01                | 597.31  | 5749       | 50486      | -4.98%                 |
| 54   | 25  | 2.0      | 14.73                | 828.80  | 0.91           | 12.93                | 486.02  | 5303       | 48564      | -12.22%                |
| 55   | 25  | 2.0      | 12.96                | 850.70  | 0.29           | 12.28                | 406.07  | 5402       | 47615      | -5.30%                 |
| 56   | 25  | 2.0      | 14.39                | 974.90  | 1.05           | 13.90                | 558.28  | 5418       | 51102      | -3.45%                 |
| 57   | 25  | 2.0      | 14.45                | 3770.04 | 0.31           | 11.37                | 360.71  | 4917       | 44620      | -21.36%                |
| 58   | 25  | 2.0      | 13.93                | 1099.90 | 0.90           | 12.84                | 488.31  | 5612       | 50543      | -7.78%                 |
| 59   | 25  | 2.0      | 13.30                | 777.40  | 0.26           | 12.36                | 429.53  | 5405       | 48186      | -7.06%                 |
| 60   | 25  | 2.0      | 14.92                | 751.20  | 0.86           | 14.23                | 539.26  | 5397       | 47578      | -4.59%                 |
| 61   | 25  | 2.0      | 15.48                | 630.90  | 0.35           | 12.28                | 488.30  | 5202       | 48575      | -20.65%                |
| 62   | 25  | 2.0      | 15.50                | 904.60  | 0.60           | 12.80                | 521.06  | 5446       | 49819      | -17.41%                |
| 63   | 25  | 2.0      | 14.26                | 584.70  | 1.52           | 13.37                | 946.72  | 5839       | 50658      | -6.22%                 |
| 64   | 25  | 2.0      | 20.16                | 616.70  | 1.22           | 18.16                | 3898.11 | 8269       | 72209      | -9.92%                 |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 65   | 25  | 2.0      | 14.48                | 640.90  | 1.45           | 13.39                | 578.84 | 5835       | 51753      | -7.51%                 |
| 66   | 25  | 2.0      | 16.85                | 607.20  | 0.32           | 16.16                | 611.14 | 6366       | 56216      | -4.09%                 |
| 67   | 25  | 2.0      | 16.38                | 710.20  | 0.82           | 13.10                | 425.87 | 5430       | 48372      | -20.00%                |
| 68   | 25  | 2.0      | 14.46                | 813.00  | 0.30           | 14.11                | 523.76 | 5512       | 50979      | -2.38%                 |
| 69   | 25  | 2.0      | 7.54                 | 359.20  | 0.24           | 7.41                 | 458.64 | 5398       | 50068      | -1.65%                 |
| 70   | 25  | 2.0      | 12.16                | 879.60  | 0.29           | 11.51                | 358.55 | 4871       | 45564      | -5.39%                 |
| 71   | 25  | 2.0      | 12.68                | 3844.08 | 1.82           | 12.07                | 447.32 | 5012       | 46057      | -4.82%                 |
| 72   | 25  | 2.0      | 10.59                | 405.10  | 0.07           | 9.72                 | 899.41 | 7592       | 69111      | -8.19%                 |
| 73   | 25  | 2.0      | 12.72                | 882.40  | 0.38           | 11.80                | 446.76 | 5321       | 48942      | -7.20%                 |
| 74   | 25  | 2.0      | 16.52                | 937.60  | 0.46           | 12.90                | 390.05 | 5275       | 48162      | -21.91%                |
| 75   | 25  | 2.0      | 12.38                | 765.90  | 0.64           | 12.23                | 331.00 | 5175       | 46287      | -1.27%                 |
| 76   | 50  | 0.1      | 13.31                | 4289.80 | 0.24           | 12.88                | 3.48   | 340        | 3073       | -3.24%                 |
| 77   | 50  | 0.1      | 2.54                 | 3611.12 | 0.11           | 2.39                 | 3.90   | 362        | 3210       | -5.95%                 |
| 78   | 50  | 0.1      | 3.12                 | 3610.67 | 0.02           | 2.33                 | 3.31   | 381        | 3282       | -25.16%                |
| 79   | 50  | 0.1      | 4.75                 | 3617.11 | 0.01           | 2.25                 | 2.78   | 289        | 2902       | -52.62%                |
| 80   | 50  | 0.1      | 1.91                 | 3636.41 | 0.09           | 1.84                 | 3.68   | 363        | 2885       | -3.40%                 |
| 81   | 50  | 0.1      | 4.99                 | 3621.79 | 0.15           | 2.28                 | 3.67   | 371        | 3218       | -54.24%                |
| 82   | 50  | 0.1      | 2.60                 | 3611.40 | 0.02           | 2.30                 | 2.83   | 314        | 3006       | -11.44%                |
| 83   | 50  | 0.1      | 2.43                 | 3623.80 | 0.14           | 1.91                 | 3.11   | 321        | 3077       | -21.40%                |
| 84   | 50  | 0.1      | 2.30                 | 3623.38 | 0.26           | 2.22                 | 3.30   | 355        | 3198       | -3.50%                 |
| 85   | 50  | 0.1      | 3.42                 | 3624.27 | 0.20           | 2.42                 | 3.19   | 293        | 3111       | -29.22%                |
| 86   | 50  | 0.1      | 12.32                | 3999.92 | 0.17           | 12.19                | 3.01   | 318        | 2869       | -1.06%                 |
| 87   | 50  | 0.1      | 12.41                | 3989.07 | 0.14           | 12.15                | 2.33   | 322        | 3112       | -2.10%                 |
| 88   | 50  | 0.1      | 2.54                 | 3623.76 | 0.27           | 2.47                 | 4.09   | 356        | 3149       | -2.42%                 |
| 89   | 50  | 0.1      | 5.30                 | 3619.14 | 0.09           | 2.40                 | 3.39   | 362        | 3152       | -54.66%                |
| 90   | 50  | 0.1      | 4.08                 | 3622.31 | 0.05           | 2.33                 | 3.40   | 339        | 3135       | -42.79%                |
| 91   | 50  | 0.1      | 2.87                 | 3623.80 | 0.22           | 2.82                 | 2.79   | 306        | 2917       | -1.80%                 |
| 92   | 50  | 0.1      | 2.65                 | 3623.15 | 0.01           | 2.65                 | 3.09   | 323        | 3035       | -0.19%                 |
| 93   | 50  | 0.1      | 2.33                 | 3623.84 | 0.06           | 2.26                 | 2.86   | 313        | 2902       | -3.15%                 |
| 94   | 50  | 0.1      | 14.36                | 4053.18 | 0.12           | 13.64                | 2.77   | 307        | 2850       | -5.03%                 |
| 95   | 50  | 0.1      | 2.05                 | 3624.75 | 0.24           | 1.88                 | 3.20   | 350        | 3090       | -8.18%                 |
| 96   | 50  | 0.1      | 5.00                 | 3617.77 | 0.15           | 2.78                 | 3.68   | 370        | 3416       | -44.41%                |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 97   | 50  | 0.1      | 2.41                 | 3629.96 | 0.19           | 2.07                 | 3.13   | 344        | 2970       | -13.74%                |
| 98   | 50  | 0.1      | 3.18                 | 3621.90 | 0.15           | 2.80                 | 3.53   | 342        | 3092       | -12.00%                |
| 99   | 50  | 0.1      | 2.50                 | 3616.26 | 0.21           | 1.93                 | 3.25   | 323        | 3088       | -22.98%                |
| 100  | 50  | 0.1      | 4.32                 | 3609.72 | 0.28           | 2.18                 | 3.07   | 303        | 3152       | -49.50%                |
| 101  | 50  | 0.5      | 2.46                 | 3605.90 | 0.13           | 2.43                 | 37.22  | 1699       | 14407      | -1.23%                 |
| 102  | 50  | 0.5      | 7.46                 | 3621.85 | 0.14           | 7.39                 | 45.69  | 1662       | 15390      | -0.91%                 |
| 103  | 50  | 0.5      | 7.78                 | 3620.20 | 0.11           | 6.87                 | 41.93  | 1696       | 15168      | -11.67%                |
| 104  | 50  | 0.5      | 9.06                 | 3627.14 | 0.19           | 7.30                 | 45.92  | 1584       | 15245      | -19.43%                |
| 105  | 50  | 0.5      | 6.53                 | 3669.47 | 0.12           | 6.05                 | 41.04  | 1612       | 13863      | -7.37%                 |
| 106  | 50  | 0.5      | 8.88                 | 3642.91 | 0.14           | 6.81                 | 43.04  | 1528       | 14901      | -23.27%                |
| 107  | 50  | 0.5      | 7.14                 | 3668.60 | 0.04           | 6.81                 | 42.92  | 1605       | 14992      | -4.64%                 |
| 108  | 50  | 0.5      | 13.74                | 4052.75 | 0.32           | 13.57                | 49.93  | 1619       | 15235      | -1.25%                 |
| 109  | 50  | 0.5      | 6.66                 | 3645.66 | 0.30           | 6.51                 | 37.78  | 1590       | 14725      | -2.32%                 |
| 110  | 50  | 0.5      | 8.62                 | 3650.40 | 0.17           | 7.87                 | 47.33  | 1795       | 15831      | -8.69%                 |
| 111  | 50  | 0.5      | 2.47                 | 3623.50 | 0.17           | 2.41                 | 40.73  | 1623       | 14710      | -2.56%                 |
| 112  | 50  | 0.5      | 2.94                 | 3619.58 | 0.22           | 2.39                 | 42.25  | 1661       | 14322      | -18.66%                |
| 113  | 50  | 0.5      | 7.56                 | 3644.29 | 0.14           | 6.81                 | 44.76  | 1700       | 15100      | -9.89%                 |
| 114  | 50  | 0.5      | 9.19                 | 3643.95 | 0.06           | 6.98                 | 36.68  | 1640       | 14675      | -23.98%                |
| 115  | 50  | 0.5      | 8.52                 | 3643.58 | 0.05           | 7.43                 | 52.08  | 1819       | 15630      | -12.80%                |
| 116  | 50  | 0.5      | 7.61                 | 3648.49 | 0.28           | 6.85                 | 41.90  | 1489       | 14732      | -10.08%                |
| 117  | 50  | 0.5      | 8.49                 | 3647.74 | 0.17           | 7.00                 | 51.41  | 1654       | 15229      | -17.59%                |
| 118  | 50  | 0.5      | 13.24                | 4029.41 | 0.13           | 12.97                | 36.34  | 1487       | 14757      | -2.04%                 |
| 119  | 50  | 0.5      | 2.84                 | 3624.77 | 0.04           | 2.18                 | 38.20  | 1625       | 14737      | -23.23%                |
| 120  | 50  | 0.5      | 6.45                 | 3644.03 | 0.24           | 6.20                 | 41.55  | 1601       | 15021      | -3.84%                 |
| 121  | 50  | 0.5      | 9.30                 | 3627.63 | 0.23           | 7.12                 | 55.87  | 1725       | 15370      | -23.37%                |
| 122  | 50  | 0.5      | 7.09                 | 3646.86 | 0.29           | 6.33                 | 41.53  | 1540       | 14317      | -10.62%                |
| 123  | 50  | 0.5      | 7.81                 | 3638.27 | 0.21           | 7.63                 | 51.80  | 1756       | 15785      | -2.34%                 |
| 124  | 50  | 0.5      | 7.17                 | 3626.09 | 0.28           | 6.48                 | 42.39  | 1647       | 14537      | -9.56%                 |
| 125  | 50  | 0.5      | 8.27                 | 3619.02 | 0.51           | 6.71                 | 44.86  | 1507       | 14612      | -18.81%                |
| 126  | 50  | 2.0      | 7.10                 | 3660.80 | 0.15           | 6.65                 | 438.96 | 5407       | 49006      | -6.28%                 |
| 127  | 50  | 2.0      | 13.80                | 3742.81 | 0.11           | 13.58                | 493.45 | 5519       | 51196      | -1.60%                 |
| 128  | 50  | 2.0      | 13.42                | 3720.23 | 0.12           | 12.83                | 429.89 | 5221       | 48831      | -4.39%                 |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 129  | 50  | 2.0      | 15.08                | 3806.36 | 0.34           | 14.03                | 586.23 | 5529       | 50753      | -6.93%                 |
| 130  | 50  | 2.0      | 12.15                | 4124.58 | 0.04           | 11.57                | 424.40 | 5041       | 46431      | -4.82%                 |
| 131  | 50  | 2.0      | 13.96                | 3846.18 | 0.47           | 11.90                | 511.17 | 5226       | 48019      | -14.76%                |
| 132  | 50  | 2.0      | 13.52                | 3797.90 | 0.05           | 13.03                | 481.43 | 5514       | 49190      | -3.60%                 |
| 133  | 50  | 2.0      | 7.08                 | 3650.09 | 0.19           | 6.92                 | 545.30 | 5684       | 50653      | -2.28%                 |
| 134  | 50  | 2.0      | 11.84                | 4005.65 | 0.41           | 11.58                | 511.82 | 5139       | 47087      | -2.25%                 |
| 135  | 50  | 2.0      | 14.95                | 4096.08 | 0.20           | 14.56                | 584.28 | 5794       | 52566      | -2.60%                 |
| 136  | 50  | 2.0      | 6.70                 | 3645.09 | 0.18           | 6.28                 | 397.98 | 4900       | 46795      | -6.20%                 |
| 137  | 50  | 2.0      | 7.18                 | 3648.72 | 0.24           | 7.06                 | 435.43 | 5370       | 47135      | -1.63%                 |
| 138  | 50  | 2.0      | 13.71                | 4044.07 | 0.15           | 13.53                | 555.56 | 5424       | 50299      | -1.35%                 |
| 139  | 50  | 2.0      | 14.16                | 3948.95 | 0.23           | 12.82                | 445.08 | 5238       | 48004      | -9.45%                 |
| 140  | 50  | 2.0      | 14.47                | 4036.42 | 0.08           | 13.35                | 549.98 | 5664       | 50458      | -7.75%                 |
| 141  | 50  | 2.0      | 13.54                | 4012.63 | 0.79           | 13.29                | 563.07 | 5531       | 49726      | -1.88%                 |
| 142  | 50  | 2.0      | 14.09                | 4056.53 | 0.06           | 13.81                | 487.72 | 5416       | 49483      | -1.95%                 |
| 143  | 50  | 2.0      | 6.92                 | 3652.33 | 0.33           | 6.85                 | 457.84 | 5432       | 49718      | -1.04%                 |
| 144  | 50  | 2.0      | 7.06                 | 3645.63 | 0.11           | 6.91                 | 528.58 | 5683       | 51919      | -2.15%                 |
| 145  | 50  | 2.0      | 11.93                | 3980.05 | 0.24           | 11.60                | 410.90 | 5279       | 45479      | -2.77%                 |
| 146  | 50  | 2.0      | 15.39                | 3784.06 | 0.23           | 13.82                | 515.28 | 5711       | 51348      | -10.20%                |
| 147  | 50  | 2.0      | 13.24                | 3818.03 | 0.27           | 12.81                | 468.59 | 5573       | 48445      | -3.20%                 |
| 148  | 50  | 2.0      | 14.55                | 3947.41 | 0.11           | 14.45                | 548.18 | 5847       | 53777      | -0.65%                 |
| 149  | 50  | 2.0      | 12.87                | 3772.46 | 0.35           | 12.75                | 483.47 | 5256       | 49034      | -0.92%                 |
| 150  | 50  | 2.0      | 14.10                | 3707.72 | 0.15           | 11.42                | 434.35 | 5343       | 46459      | -19.05%                |
| 151  | 75  | 0.1      | 2.41                 | 3606.90 | 0.07           | 2.27                 | 3.61   | 324        | 2923       | -5.61%                 |
| 152  | 75  | 0.1      | 13.76                | 4018.50 | 0.15           | 13.74                | 4.19   | 336        | 3112       | -0.17%                 |
| 153  | 75  | 0.1      | 3.03                 | 3606.20 | 0.11           | 2.43                 | 4.46   | 332        | 3251       | -19.96%                |
| 154  | 75  | 0.1      | 3.00                 | 3615.41 | 0.10           | 2.27                 | 3.63   | 346        | 3014       | -24.53%                |
| 155  | 75  | 0.1      | 6.91                 | 3712.40 | 0.15           | 6.90                 | 4.25   | 372        | 3144       | -0.18%                 |
| 156  | 75  | 0.1      | 2.55                 | 3615.45 | 0.19           | 2.15                 | 3.86   | 344        | 3054       | -15.67%                |
| 157  | 75  | 0.1      | 13.28                | 3732.92 | 0.23           | 13.01                | 4.35   | 337        | 3057       | -2.06%                 |
| 158  | 75  | 0.1      | 2.31                 | 3615.57 | 0.15           | 2.10                 | 3.94   | 311        | 2886       | -8.99%                 |
| 159  | 75  | 0.1      | 2.44                 | 3616.11 | 0.23           | 2.33                 | 4.34   | 363        | 3182       | -4.51%                 |
| 160  | 75  | 0.1      | 2.73                 | 3613.54 | 0.15           | 2.05                 | 3.98   | 310        | 2894       | -24.84%                |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|-------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 161  | 75  | 0.1      | 2.62                 | 3616.25 | 0.10           | 2.41                 | 5.26  | 381        | 3012       | -8.13%                 |
| 162  | 75  | 0.1      | 2.54                 | 3610.60 | 0.08           | 2.28                 | 3.82  | 289        | 2866       | -10.17%                |
| 163  | 75  | 0.1      | 2.20                 | 3605.80 | 0.09           | 2.16                 | 3.67  | 321        | 2957       | -1.76%                 |
| 164  | 75  | 0.1      | 13.06                | 3978.80 | 0.13           | 12.88                | 3.70  | 321        | 2802       | -1.35%                 |
| 165  | 75  | 0.1      | 13.17                | 3723.88 | 0.20           | 12.94                | 4.25  | 366        | 2979       | -1.75%                 |
| 166  | 75  | 0.1      | 2.80                 | 3615.68 | 0.04           | 2.40                 | 4.03  | 347        | 3094       | -14.14%                |
| 167  | 75  | 0.1      | 2.65                 | 3614.89 | 0.23           | 2.62                 | 4.51  | 326        | 3113       | -0.96%                 |
| 168  | 75  | 0.1      | 2.37                 | 3615.71 | 0.06           | 1.91                 | 4.01  | 326        | 2973       | -19.41%                |
| 169  | 75  | 0.1      | 13.05                | 3754.21 | 0.12           | 12.97                | 3.28  | 316        | 3056       | -0.66%                 |
| 170  | 75  | 0.1      | 2.53                 | 3615.36 | 0.17           | 2.50                 | 4.50  | 341        | 3220       | -1.43%                 |
| 171  | 75  | 0.1      | 13.51                | 3738.69 | 0.05           | 11.97                | 4.03  | 364        | 2914       | -11.36%                |
| 172  | 75  | 0.1      | 2.68                 | 3615.15 | 0.09           | 2.57                 | 3.69  | 317        | 2953       | -4.26%                 |
| 173  | 75  | 0.1      | 2.54                 | 3614.02 | 0.05           | 2.36                 | 3.85  | 304        | 3178       | -7.25%                 |
| 174  | 75  | 0.1      | 2.34                 | 3616.30 | 0.12           | 2.28                 | 4.55  | 384        | 3245       | -2.55%                 |
| 175  | 75  | 0.1      | 3.05                 | 3623.43 | 0.11           | 2.73                 | 4.84  | 377        | 3148       | -10.61%                |
| 176  | 75  | 0.5      | 6.92                 | 3665.10 | 0.21           | 6.82                 | 50.87 | 1592       | 14775      | -1.37%                 |
| 177  | 75  | 0.5      | 2.42                 | 3605.70 | 0.14           | 2.15                 | 54.72 | 1793       | 15788      | -11.43%                |
| 178  | 75  | 0.5      | 8.04                 | 3670.30 | 0.07           | 7.36                 | 49.91 | 1751       | 15692      | -8.42%                 |
| 179  | 75  | 0.5      | 7.20                 | 3625.83 | 0.11           | 7.08                 | 43.44 | 1599       | 14957      | -1.68%                 |
| 180  | 75  | 0.5      | 2.60                 | 3607.30 | 0.15           | 2.41                 | 53.02 | 1700       | 14613      | -7.41%                 |
| 181  | 75  | 0.5      | 7.39                 | 3626.65 | 0.16           | 7.17                 | 45.02 | 1701       | 15252      | -2.94%                 |
| 182  | 75  | 0.5      | 2.44                 | 3614.02 | 0.21           | 2.35                 | 49.70 | 1587       | 14798      | -3.72%                 |
| 183  | 75  | 0.5      | 6.86                 | 3626.84 | 0.14           | 6.56                 | 49.40 | 1596       | 14297      | -4.42%                 |
| 184  | 75  | 0.5      | 7.01                 | 3626.06 | 0.22           | 6.52                 | 49.56 | 1662       | 14730      | -6.99%                 |
| 185  | 75  | 0.5      | 7.31                 | 3624.66 | 0.11           | 6.97                 | 49.24 | 1673       | 15145      | -4.63%                 |
| 186  | 75  | 0.5      | 7.53                 | 3626.13 | 0.08           | 7.44                 | 52.63 | 1770       | 15526      | -1.09%                 |
| 187  | 75  | 0.5      | 7.57                 | 3631.30 | 0.03           | 7.19                 | 45.03 | 1740       | 15286      | -5.10%                 |
| 188  | 75  | 0.5      | 6.52                 | 3620.10 | 0.16           | 6.38                 | 52.23 | 1627       | 14820      | -2.25%                 |
| 189  | 75  | 0.5      | 2.71                 | 3609.70 | 0.13           | 2.54                 | 45.43 | 1532       | 14438      | -6.22%                 |
| 190  | 75  | 0.5      | 2.52                 | 3615.09 | 0.13           | 2.52                 | 47.84 | 1615       | 14965      | -0.36%                 |
| 191  | 75  | 0.5      | 7.39                 | 3625.98 | 0.15           | 7.05                 | 50.27 | 1579       | 15233      | -4.62%                 |
| 192  | 75  | 0.5      | 13.07                | 3729.23 | 0.23           | 13.05                | 57.94 | 1736       | 15594      | -0.17%                 |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 193  | 75  | 0.5      | 7.35                 | 3625.73 | 0.13           | 6.65                 | 49.93  | 1656       | 14652      | -9.47%                 |
| 194  | 75  | 0.5      | 2.28                 | 3616.54 | 0.26           | 2.27                 | 50.67  | 1485       | 15244      | -0.80%                 |
| 195  | 75  | 0.5      | 7.56                 | 3626.31 | 0.22           | 7.11                 | 55.38  | 1661       | 15499      | -6.01%                 |
| 196  | 75  | 0.5      | 2.65                 | 3615.08 | 0.17           | 2.28                 | 46.11  | 1694       | 14922      | -14.08%                |
| 197  | 75  | 0.5      | 6.99                 | 3624.52 | 0.11           | 6.93                 | 47.10  | 1788       | 15107      | -0.97%                 |
| 198  | 75  | 0.5      | 7.35                 | 3624.74 | 0.08           | 7.30                 | 55.48  | 1784       | 15973      | -0.78%                 |
| 199  | 75  | 0.5      | 11.91                | 3721.12 | 0.14           | 11.55                | 47.16  | 1621       | 14353      | -2.99%                 |
| 200  | 75  | 0.5      | 8.10                 | 3633.66 | 0.09           | 7.73                 | 55.49  | 1751       | 15832      | -4.58%                 |
| 201  | 75  | 2.0      | 12.74                | 3809.00 | 0.11           | 12.46                | 432.28 | 5375       | 48659      | -2.16%                 |
| 202  | 75  | 2.0      | 7.63                 | 3645.50 | 0.17           | 7.04                 | 618.55 | 5977       | 53451      | -7.78%                 |
| 203  | 75  | 2.0      | 13.87                | 4060.70 | 0.18           | 13.16                | 585.97 | 5715       | 50252      | -5.12%                 |
| 204  | 75  | 2.0      | 13.18                | 3728.00 | 0.23           | 13.07                | 502.49 | 5224       | 48638      | -0.87%                 |
| 205  | 75  | 2.0      | 12.65                | 4086.60 | 0.07           | 12.28                | 432.23 | 5135       | 47594      | -2.88%                 |
| 206  | 75  | 2.0      | 13.34                | 3728.05 | 0.31           | 13.32                | 529.50 | 5366       | 50016      | -0.14%                 |
| 207  | 75  | 2.0      | 7.05                 | 3626.84 | 0.22           | 6.95                 | 547.73 | 5465       | 50063      | -1.37%                 |
| 208  | 75  | 2.0      | 12.57                | 3748.83 | 0.16           | 11.51                | 481.91 | 5099       | 47644      | -8.45%                 |
| 209  | 75  | 2.0      | 12.63                | 3737.31 | 0.19           | 12.31                | 473.09 | 5417       | 47875      | -2.54%                 |
| 210  | 75  | 2.0      | 13.01                | 3731.27 | 0.11           | 12.85                | 584.50 | 5696       | 50439      | -1.18%                 |
| 211  | 75  | 2.0      | 14.07                | 3742.84 | 0.07           | 13.56                | 520.24 | 5486       | 52188      | -3.62%                 |
| 212  | 75  | 2.0      | 13.28                | 4104.80 | 0.04           | 13.16                | 434.23 | 5591       | 50208      | -0.90%                 |
| 213  | 75  | 2.0      | 12.01                | 4364.50 | 0.09           | 11.75                | 450.73 | 5628       | 48084      | -2.16%                 |
| 214  | 75  | 2.0      | 7.49                 | 3742.80 | 0.11           | 7.05                 | 446.81 | 5276       | 47683      | -5.97%                 |
| 215  | 75  | 2.0      | 7.38                 | 3624.47 | 0.24           | 7.28                 | 506.57 | 5308       | 48848      | -1.42%                 |
| 216  | 75  | 2.0      | 13.28                | 3735.99 | 0.13           | 13.07                | 516.20 | 5513       | 48266      | -1.53%                 |
| 217  | 75  | 2.0      | 7.52                 | 3625.88 | 0.26           | 7.44                 | 508.44 | 5289       | 48578      | -1.00%                 |
| 218  | 75  | 2.0      | 12.83                | 3737.52 | 0.12           | 12.55                | 474.24 | 5255       | 48578      | -2.22%                 |
| 219  | 75  | 2.0      | 7.19                 | 3629.29 | 0.25           | 7.13                 | 529.55 | 5464       | 49668      | -0.92%                 |
| 220  | 75  | 2.0      | 13.82                | 3743.85 | 0.13           | 13.61                | 571.95 | 5888       | 50099      | -1.51%                 |
| 221  | 75  | 2.0      | 6.79                 | 3625.73 | 0.14           | 6.65                 | 483.48 | 5255       | 48812      | -1.96%                 |
| 222  | 75  | 2.0      | 13.10                | 3732.00 | 0.10           | 13.01                | 323.69 | 5019       | 49098      | -0.72%                 |
| 223  | 75  | 2.0      | 13.56                | 3740.45 | 0.16           | 13.45                | 594.90 | 5687       | 51306      | -0.77%                 |
| 224  | 75  | 2.0      | 6.77                 | 3626.57 | 0.04           | 6.32                 | 583.58 | 5665       | 50148      | -6.65%                 |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)    | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 225  | 75  | 2.0      | 14.49                | 3783.96 | 0.13           | 14.25                | 572.00 | 5640       | 51106      | -1.63%                 |
| 226  | 100 | 0.1      | 7.94                 | 3622.20 | 0.08           | 7.50                 | 4.72   | 332        | 3104       | -5.52%                 |
| 227  | 100 | 0.1      | 2.68                 | 3693.47 | 0.14           | 2.37                 | 5.57   | 342        | 3000       | -11.64%                |
| 228  | 100 | 0.1      | 12.61                | 4177.40 | 0.16           | 12.49                | 4.92   | 356        | 2877       | -0.97%                 |
| 229  | 100 | 0.1      | 2.83                 | 3692.54 | 0.10           | 2.21                 | 4.51   | 330        | 2917       | -21.96%                |
| 230  | 100 | 0.1      | 2.73                 | 3701.43 | 0.02           | 2.23                 | 4.98   | 323        | 2946       | -18.27%                |
| 231  | 100 | 0.1      | 3.14                 | 3689.92 | 0.06           | 2.46                 | 5.22   | 375        | 3075       | -21.66%                |
| 232  | 100 | 0.1      | 2.72                 | 3693.98 | 0.13           | 2.61                 | 5.43   | 340        | 3102       | -3.99%                 |
| 233  | 100 | 0.1      | 12.14                | 4284.02 | 0.23           | 11.82                | 3.78   | 361        | 3195       | -2.66%                 |
| 234  | 100 | 0.1      | 13.13                | 4308.74 | 0.10           | 12.93                | 5.12   | 363        | 3098       | -1.48%                 |
| 235  | 100 | 0.1      | 6.95                 | 3736.23 | 0.16           | 6.80                 | 4.41   | 330        | 3060       | -2.07%                 |
| 236  | 100 | 0.1      | 2.86                 | 3605.10 | 0.09           | 2.47                 | 5.66   | 393        | 3181       | -13.64%                |
| 237  | 100 | 0.1      | 6.96                 | 3740.43 | 0.04           | 6.95                 | 5.48   | 356        | 2933       | -0.08%                 |
| 238  | 100 | 0.1      | 7.45                 | 3674.20 | 0.14           | 7.40                 | 5.50   | 326        | 3146       | -0.74%                 |
| 239  | 100 | 0.1      | 2.62                 | 3685.80 | 0.11           | 1.87                 | 5.31   | 331        | 3136       | -28.73%                |
| 240  | 100 | 0.1      | 7.30                 | 3676.80 | 0.06           | 6.50                 | 7.51   | 349        | 2965       | -11.03%                |
| 241  | 100 | 0.1      | 14.12                | 4425.62 | 0.07           | 13.34                | 7.62   | 312        | 3010       | -5.54%                 |
| 242  | 100 | 0.1      | 12.83                | 4317.80 | 0.13           | 12.75                | 8.17   | 345        | 3003       | -0.58%                 |
| 243  | 100 | 0.1      | 2.68                 | 3691.62 | 0.16           | 2.67                 | 5.25   | 330        | 3016       | -0.45%                 |
| 244  | 100 | 0.1      | 2.41                 | 3608.00 | 0.22           | 2.39                 | 5.19   | 335        | 2975       | -0.64%                 |
| 245  | 100 | 0.1      | 2.97                 | 3694.13 | 0.11           | 2.26                 | 5.67   | 369        | 3088       | -23.93%                |
| 246  | 100 | 0.1      | 2.77                 | 3611.20 | 0.08           | 2.71                 | 4.38   | 314        | 2875       | -2.32%                 |
| 247  | 100 | 0.1      | 2.48                 | 3615.60 | 0.06           | 2.29                 | 4.54   | 359        | 3006       | -7.80%                 |
| 248  | 100 | 0.1      | 4.35                 | 3608.94 | 0.30           | 2.81                 | 5.57   | 367        | 3326       | -35.50%                |
| 249  | 100 | 0.1      | 2.40                 | 3611.90 | 0.01           | 2.15                 | 3.63   | 358        | 3124       | -10.20%                |
| 250  | 100 | 0.1      | 3.41                 | 3615.60 | 0.07           | 2.43                 | 4.88   | 314        | 3004       | -28.80%                |
| 251  | 100 | 0.5      | 14.15                | 4379.00 | 0.09           | 14.02                | 55.77  | 1770       | 16008      | -0.96%                 |
| 252  | 100 | 0.5      | 6.88                 | 3736.54 | 0.05           | 6.73                 | 57.22  | 1822       | 14901      | -2.12%                 |
| 253  | 100 | 0.5      | 2.61                 | 3611.10 | 0.18           | 2.24                 | 50.16  | 1627       | 14798      | -13.97%                |
| 254  | 100 | 0.5      | 6.91                 | 3729.63 | 0.12           | 6.66                 | 44.31  | 1635       | 14994      | -3.70%                 |
| 255  | 100 | 0.5      | 7.17                 | 3744.79 | 0.02           | 6.71                 | 39.85  | 1713       | 14601      | -6.50%                 |
| 256  | 100 | 0.5      | 7.75                 | 3729.32 | 0.11           | 6.80                 | 46.09  | 1654       | 14666      | -12.18%                |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |          | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|----------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)     | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 257  | 100 | 0.5      | 7.10                 | 3732.47  | 0.13           | 6.98                 | 61.10  | 1806       | 15422      | -1.64%                 |
| 258  | 100 | 0.5      | 2.09                 | 3691.56  | 0.23           | 2.08                 | 51.24  | 1637       | 14789      | -0.62%                 |
| 259  | 100 | 0.5      | 2.75                 | 3689.87  | 0.12           | 2.62                 | 49.22  | 1603       | 15254      | -4.72%                 |
| 260  | 100 | 0.5      | 2.43                 | 3688.63  | 0.03           | 2.30                 | 47.23  | 1501       | 14739      | -5.00%                 |
| 261  | 100 | 0.5      | 7.85                 | 3722.30  | 0.19           | 7.72                 | 63.34  | 1769       | 15723      | -1.57%                 |
| 262  | 100 | 0.5      | 12.55                | 4303.91  | 0.02           | 12.43                | 56.05  | 1648       | 15043      | -0.93%                 |
| 263  | 100 | 0.5      | 13.60                | 4234.90  | 0.15           | 12.59                | 61.90  | 1874       | 15414      | -7.41%                 |
| 264  | 100 | 0.5      | 7.31                 | 3736.39  | 0.10           | 6.93                 | 53.19  | 1637       | 15294      | -5.20%                 |
| 265  | 100 | 0.5      | 12.68                | 3868.80  | 0.05           | 12.34                | 74.67  | 1675       | 15257      | -2.70%                 |
| 266  | 100 | 0.5      | 2.97                 | 3693.67  | 0.08           | 2.78                 | 86.12  | 1632       | 15163      | -6.63%                 |
| 267  | 100 | 0.5      | 2.55                 | 3611.00  | 0.04           | 2.44                 | 42.86  | 1719       | 15463      | -4.32%                 |
| 268  | 100 | 0.5      | 7.75                 | 3738.43  | 0.08           | 7.25                 | 55.62  | 1719       | 15167      | -6.53%                 |
| 269  | 100 | 0.5      | 7.62                 | 3725.90  | 0.19           | 7.44                 | 52.90  | 1717       | 15111      | -2.36%                 |
| 270  | 100 | 0.5      | 7.86                 | 3742.27  | 0.06           | 7.22                 | 54.98  | 1714       | 15426      | -8.14%                 |
| 271  | 100 | 0.5      | 7.16                 | 3646.30  | 0.07           | 7.06                 | 50.65  | 1692       | 15050      | -1.38%                 |
| 272  | 100 | 0.5      | 12.61                | 11024.40 | 0.21           | 11.97                | 57.43  | 1732       | 14969      | -5.07%                 |
| 273  | 100 | 0.5      | 8.62                 | 3637.80  | 0.30           | 7.94                 | 56.08  | 1782       | 15831      | -7.89%                 |
| 274  | 100 | 0.5      | 7.20                 | 3653.90  | 0.01           | 6.77                 | 36.63  | 1623       | 15162      | -5.97%                 |
| 275  | 100 | 0.5      | 8.05                 | 3660.50  | 0.12           | 7.22                 | 59.52  | 1647       | 15230      | -10.24%                |
| 276  | 100 | 2.0      | 2.77                 | 3604.00  | 0.06           | 2.70                 | 577.68 | 5538       | 51368      | -2.58%                 |
| 277  | 100 | 2.0      | 12.95                | 4350.05  | 0.08           | 12.13                | 531.47 | 5166       | 50034      | -6.34%                 |
| 278  | 100 | 2.0      | 7.32                 | 3742.40  | 0.03           | 6.72                 | 230.40 | 5574       | 49533      | -8.28%                 |
| 279  | 100 | 2.0      | 12.63                | 4314.04  | 0.05           | 12.03                | 216.37 | 5458       | 47347      | -4.74%                 |
| 280  | 100 | 2.0      | 12.47                | 4289.95  | 0.07           | 11.98                | 475.01 | 5357       | 46987      | -3.96%                 |
| 281  | 100 | 2.0      | 13.01                | 4312.90  | 0.09           | 12.71                | 549.58 | 5607       | 49435      | -2.29%                 |
| 282  | 100 | 2.0      | 13.16                | 4339.81  | 0.17           | 13.11                | 577.45 | 5595       | 49180      | -0.34%                 |
| 283  | 100 | 2.0      | 6.96                 | 3736.75  | 0.23           | 6.53                 | 613.80 | 5561       | 49080      | -6.19%                 |
| 284  | 100 | 2.0      | 7.27                 | 3737.38  | 0.06           | 7.26                 | 492.16 | 5564       | 50486      | -0.18%                 |
| 285  | 100 | 2.0      | 12.36                | 4302.11  | 0.23           | 12.27                | 537.55 | 5481       | 48952      | -0.76%                 |
| 286  | 100 | 2.0      | 14.39                | 3803.20  | 0.17           | 13.43                | 673.41 | 5855       | 51983      | -6.67%                 |
| 287  | 100 | 2.0      | 2.49                 | 3689.67  | 0.03           | 2.39                 | 552.17 | 5466       | 48276      | -4.23%                 |
| 288  | 100 | 2.0      | 3.03                 | 3609.40  | 0.15           | 2.65                 | 619.57 | 5604       | 51124      | -12.63%                |

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Table 1: Result of SimExact X SimSA-Expected (Continued)

| Inst | $n$ | $\delta$ | SimExact             |          | SimSA-Expected |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|----------|----------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | E-RPD <sup>(a)</sup> | T(s)     | D-RPD          | E-RPD <sup>(b)</sup> | T(s)   | $\#\rho_S$ | $\#\rho_L$ |                        |
| 289  | 100 | 2.0      | 12.66                | 4323.21  | 0.06           | 12.59                | 488.05 | 5263       | 47983      | -0.61%                 |
| 290  | 100 | 2.0      | 2.59                 | 3609.30  | 0.11           | 2.34                 | 712.85 | 5473       | 48406      | -9.46%                 |
| 291  | 100 | 2.0      | 7.84                 | 3738.96  | 0.12           | 7.33                 | 799.12 | 5708       | 51804      | -6.45%                 |
| 292  | 100 | 2.0      | 7.25                 | 3668.60  | 0.11           | 7.08                 | 510.01 | 5153       | 49437      | -2.37%                 |
| 293  | 100 | 2.0      | 13.03                | 4351.22  | 0.09           | 12.97                | 477.87 | 5456       | 48364      | -0.43%                 |
| 294  | 100 | 2.0      | 13.29                | 3835.40  | 0.03           | 13.11                | 229.74 | 5687       | 49507      | -1.39%                 |
| 295  | 100 | 2.0      | 13.57                | 4349.52  | 0.05           | 12.89                | 525.43 | 5532       | 49791      | -4.99%                 |
| 296  | 100 | 2.0      | 13.34                | 4244.40  | 0.06           | 13.18                | 523.26 | 5600       | 50335      | -1.22%                 |
| 297  | 100 | 2.0      | 6.90                 | 3632.40  | 0.12           | 6.88                 | 457.71 | 5239       | 47942      | -0.31%                 |
| 298  | 100 | 2.0      | 14.90                | 4134.42  | 0.30           | 13.61                | 558.75 | 5560       | 52383      | -8.65%                 |
| 299  | 100 | 2.0      | 12.49                | 11021.80 | 0.17           | 12.43                | 465.35 | 5264       | 48393      | -0.55%                 |
| 300  | 100 | 2.0      | 13.13                | 4045.80  | 0.10           | 12.53                | 536.40 | 5602       | 49935      | -4.57%                 |

## 2. SimSA-VaR X SimExact

Table 2: Result of SimExact x SimSA-VaR

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |      |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s) | $\#\rho_S$ | $\#\rho_L$ |                        |
| 1    | 25  | 0.1      | 19.10                | 200.30  | 0.44      | 18.09                | 8.06 | 356        | 3307       | -5.29%                 |
| 2    | 25  | 0.1      | 21.31                | 187.00  | 1.04      | 18.03                | 2.60 | 337        | 3014       | -15.42%                |
| 3    | 25  | 0.1      | 22.17                | 134.10  | 0.20      | 20.62                | 2.45 | 411        | 3699       | -6.98%                 |
| 4    | 25  | 0.1      | 21.27                | 374.80  | 0.60      | 20.32                | 1.92 | 346        | 3245       | -4.46%                 |
| 5    | 25  | 0.1      | 18.90                | 265.40  | 0.64      | 18.56                | 2.30 | 363        | 3038       | -1.83%                 |
| 6    | 25  | 0.1      | 20.96                | 228.40  | 0.50      | 19.55                | 2.26 | 354        | 3304       | -6.73%                 |
| 7    | 25  | 0.1      | 21.85                | 3604.91 | 0.23      | 16.53                | 1.75 | 314        | 2905       | -24.37%                |
| 8    | 25  | 0.1      | 20.94                | 381.00  | 0.29      | 18.74                | 1.81 | 292        | 3041       | -10.52%                |
| 9    | 25  | 0.1      | 19.47                | 346.40  | 0.35      | 17.92                | 2.13 | 379        | 3034       | -7.97%                 |
| 10   | 25  | 0.1      | 21.68                | 265.20  | 0.54      | 20.36                | 2.39 | 372        | 3268       | -6.09%                 |
| 11   | 25  | 0.1      | 22.92                | 366.60  | 0.44      | 18.26                | 2.24 | 345        | 3139       | -20.32%                |
| 12   | 25  | 0.1      | 22.92                | 168.70  | 0.36      | 17.29                | 1.84 | 342        | 2969       | -24.55%                |
| 13   | 25  | 0.1      | 19.68                | 285.30  | 0.94      | 16.99                | 1.62 | 286        | 2683       | -13.64%                |
| 14   | 25  | 0.1      | 20.79                | 342.60  | 0.34      | 19.88                | 2.93 | 357        | 3261       | -4.35%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|-------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 15   | 25  | 0.1      | 17.96                | 257.20  | 0.81      | 17.81                | 1.93  | 332        | 2935       | -0.85%                 |
| 16   | 25  | 0.1      | 22.03                | 391.40  | 0.37      | 18.26                | 2.57  | 348        | 2874       | -17.10%                |
| 17   | 25  | 0.1      | 23.30                | 243.80  | 0.47      | 18.14                | 1.71  | 341        | 2968       | -22.14%                |
| 18   | 25  | 0.1      | 19.57                | 218.00  | 0.36      | 18.07                | 3.20  | 411        | 3425       | -7.64%                 |
| 19   | 25  | 0.1      | 46.89                | 638.00  | 0.17      | 18.06                | 2.23  | 374        | 3106       | -61.49%                |
| 20   | 25  | 0.1      | 18.74                | 368.10  | 0.32      | 17.88                | 2.68  | 338        | 2980       | -4.60%                 |
| 21   | 25  | 0.1      | 18.03                | 3607.43 | 0.59      | 17.37                | 2.41  | 332        | 2945       | -3.67%                 |
| 22   | 25  | 0.1      | 53.88                | 1070.50 | 0.36      | 21.32                | 3.26  | 394        | 3513       | -60.43%                |
| 23   | 25  | 0.1      | 19.78                | 318.30  | 0.59      | 16.43                | 2.45  | 311        | 2940       | -16.96%                |
| 24   | 25  | 0.1      | 21.06                | 194.20  | 0.47      | 17.69                | 1.99  | 300        | 2928       | -16.00%                |
| 25   | 25  | 0.1      | 19.30                | 359.70  | 0.81      | 17.23                | 2.46  | 347        | 2880       | -10.74%                |
| 26   | 25  | 0.5      | 44.11                | 342.30  | 1.07      | 42.51                | 27.81 | 1576       | 13729      | -3.63%                 |
| 27   | 25  | 0.5      | 50.24                | 214.00  | 0.78      | 45.76                | 40.74 | 1739       | 15419      | -8.91%                 |
| 28   | 25  | 0.5      | 48.03                | 240.50  | 0.19      | 47.73                | 38.86 | 1805       | 16295      | -0.63%                 |
| 29   | 25  | 0.5      | 47.70                | 458.20  | 0.60      | 44.40                | 36.91 | 1693       | 14606      | -6.90%                 |
| 30   | 25  | 0.5      | 43.25                | 276.10  | 0.41      | 42.99                | 32.88 | 1519       | 14310      | -0.60%                 |
| 31   | 25  | 0.5      | 46.31                | 297.40  | 0.30      | 46.25                | 36.45 | 1747       | 15078      | -0.13%                 |
| 32   | 25  | 0.5      | 43.80                | 3617.21 | 0.17      | 41.04                | 27.67 | 1531       | 13618      | -6.30%                 |
| 33   | 25  | 0.5      | 48.01                | 460.90  | 1.20      | 44.86                | 40.77 | 1755       | 15768      | -6.55%                 |
| 34   | 25  | 0.5      | 45.77                | 432.30  | 0.73      | 42.41                | 39.75 | 1595       | 14212      | -7.35%                 |
| 35   | 25  | 0.5      | 49.53                | 400.40  | 1.02      | 46.38                | 42.55 | 1586       | 14919      | -6.35%                 |
| 36   | 25  | 0.5      | 45.54                | 450.80  | 0.47      | 43.93                | 40.23 | 1719       | 14973      | -3.54%                 |
| 37   | 25  | 0.5      | 47.01                | 266.10  | 0.47      | 44.66                | 17.29 | 1632       | 14992      | -5.00%                 |
| 38   | 25  | 0.5      | 45.63                | 291.30  | 0.65      | 44.75                | 33.20 | 1694       | 14730      | -1.93%                 |
| 39   | 25  | 0.5      | 53.83                | 432.00  | 1.26      | 52.67                | 76.09 | 2160       | 19321      | -2.16%                 |
| 40   | 25  | 0.5      | 45.28                | 325.90  | 0.00      | 43.42                | 32.65 | 1632       | 14822      | -4.09%                 |
| 41   | 25  | 0.5      | 49.58                | 467.20  | 0.24      | 49.48                | 46.62 | 1891       | 16830      | -0.20%                 |
| 42   | 25  | 0.5      | 48.01                | 309.70  | 0.93      | 44.91                | 39.77 | 1613       | 14430      | -6.47%                 |
| 43   | 25  | 0.5      | 46.57                | 252.40  | 0.29      | 45.79                | 41.26 | 1792       | 15340      | -1.67%                 |
| 44   | 25  | 0.5      | 90.73                | 243.20  | 0.25      | 45.24                | 39.49 | 1669       | 15602      | -50.13%                |
| 45   | 25  | 0.5      | 42.22                | 380.20  | 0.47      | 41.49                | 37.17 | 1614       | 14052      | -1.74%                 |
| 46   | 25  | 0.5      | 44.07                | 3626.84 | 0.79      | 43.06                | 32.03 | 1625       | 13784      | -2.30%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |         |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|---------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)    | # $\rho_S$ | # $\rho_L$ |                        |
| 47   | 25  | 0.5      | 115.70               | 307.60  | 0.80      | 53.88                | 71.51   | 1954       | 18099      | -53.43%                |
| 48   | 25  | 0.5      | 44.56                | 415.30  | 0.17      | 43.35                | 41.04   | 1605       | 14600      | -2.72%                 |
| 49   | 25  | 0.5      | 47.67                | 222.50  | 1.03      | 42.77                | 43.07   | 1508       | 14084      | -10.27%                |
| 50   | 25  | 0.5      | 44.37                | 367.70  | 1.03      | 44.21                | 41.99   | 1596       | 14034      | -0.34%                 |
| 51   | 25  | 2.0      | 86.96                | 915.20  | 0.27      | 85.52                | 362.27  | 5081       | 46399      | -1.66%                 |
| 52   | 25  | 2.0      | 92.69                | 791.40  | 0.88      | 91.74                | 486.80  | 5711       | 51099      | -1.03%                 |
| 53   | 25  | 2.0      | 91.23                | 441.10  | 0.63      | 88.21                | 451.42  | 5411       | 49240      | -3.31%                 |
| 54   | 25  | 2.0      | 90.63                | 828.80  | 0.61      | 86.19                | 377.38  | 5332       | 46863      | -4.89%                 |
| 55   | 25  | 2.0      | 87.91                | 850.70  | 0.38      | 85.54                | 445.75  | 5234       | 46282      | -2.70%                 |
| 56   | 25  | 2.0      | 90.33                | 974.90  | 0.71      | 89.76                | 454.33  | 5385       | 49253      | -0.63%                 |
| 57   | 25  | 2.0      | 84.74                | 3770.04 | 0.44      | 82.22                | 413.85  | 5047       | 45284      | -2.97%                 |
| 58   | 25  | 2.0      | 89.88                | 1099.90 | 1.65      | 88.21                | 491.79  | 5572       | 49611      | -1.85%                 |
| 59   | 25  | 2.0      | 85.94                | 777.40  | 0.43      | 85.88                | 409.47  | 5454       | 47773      | -0.07%                 |
| 60   | 25  | 2.0      | 89.82                | 751.20  | 0.89      | 89.38                | 405.55  | 5314       | 48055      | -0.49%                 |
| 61   | 25  | 2.0      | 88.05                | 630.90  | 0.35      | 86.31                | 420.67  | 5301       | 48334      | -1.98%                 |
| 62   | 25  | 2.0      | 89.08                | 904.60  | 0.90      | 87.77                | 459.10  | 5337       | 48127      | -1.47%                 |
| 63   | 25  | 2.0      | 89.73                | 584.70  | 1.08      | 89.12                | 389.23  | 5143       | 47567      | -0.68%                 |
| 64   | 25  | 2.0      | 116.19               | 616.70  | 1.03      | 111.71               | 1053.66 | 7789       | 68871      | -3.86%                 |
| 65   | 25  | 2.0      | 92.45                | 640.90  | 1.25      | 92.05                | 580.14  | 6042       | 52756      | -0.44%                 |
| 66   | 25  | 2.0      | 101.54               | 607.20  | 0.22      | 101.14               | 588.01  | 6359       | 58268      | -0.39%                 |
| 67   | 25  | 2.0      | 89.11                | 710.20  | 0.42      | 86.53                | 368.91  | 5390       | 47189      | -2.89%                 |
| 68   | 25  | 2.0      | 93.35                | 813.00  | 0.22      | 93.31                | 497.16  | 5637       | 51253      | -0.04%                 |
| 69   | 25  | 2.0      | 91.06                | 359.20  | 0.27      | 90.26                | 476.84  | 5436       | 49283      | -0.87%                 |
| 70   | 25  | 2.0      | 83.23                | 879.60  | 0.16      | 81.95                | 321.88  | 5087       | 45608      | -1.54%                 |
| 71   | 25  | 2.0      | 84.00                | 3844.08 | 0.64      | 82.06                | 288.66  | 4632       | 44784      | -2.31%                 |
| 72   | 25  | 2.0      | 115.91               | 405.10  | 0.14      | 114.59               | 965.39  | 7332       | 69347      | -1.14%                 |
| 73   | 25  | 2.0      | 87.78                | 882.40  | 0.39      | 85.99                | 488.24  | 5476       | 48375      | -2.05%                 |
| 74   | 25  | 2.0      | 88.16                | 937.60  | 0.63      | 87.10                | 463.23  | 5292       | 47667      | -1.20%                 |
| 75   | 25  | 2.0      | 84.55                | 765.90  | 0.56      | 84.49                | 426.70  | 5079       | 45848      | -0.07%                 |
| 76   | 50  | 0.1      | 44.53                | 4289.80 | 0.24      | 17.61                | 3.71    | 374        | 3035       | -60.47%                |
| 77   | 50  | 0.1      | 19.28                | 3611.12 | 0.11      | 19.07                | 3.71    | 353        | 3371       | -1.08%                 |
| 78   | 50  | 0.1      | 19.71                | 3610.67 | 0.09      | 18.74                | 3.56    | 321        | 3381       | -4.93%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|-------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 79   | 50  | 0.1      | 20.50                | 3617.11 | 0.12      | 17.90                | 3.55  | 347        | 2965       | -12.73%                |
| 80   | 50  | 0.1      | 17.69                | 3636.41 | 0.04      | 16.98                | 3.61  | 337        | 3056       | -4.03%                 |
| 81   | 50  | 0.1      | 19.86                | 3621.79 | 0.15      | 16.92                | 3.92  | 379        | 3023       | -14.80%                |
| 82   | 50  | 0.1      | 18.19                | 3611.40 | 0.25      | 17.74                | 3.39  | 319        | 3121       | -2.46%                 |
| 83   | 50  | 0.1      | 18.29                | 3623.80 | 0.29      | 18.19                | 3.58  | 320        | 3184       | -0.56%                 |
| 84   | 50  | 0.1      | 18.18                | 3623.38 | 0.38      | 17.60                | 3.84  | 350        | 3083       | -3.20%                 |
| 85   | 50  | 0.1      | 20.39                | 3624.27 | 0.17      | 17.87                | 3.76  | 320        | 2939       | -12.32%                |
| 86   | 50  | 0.1      | 43.27                | 3999.92 | 0.19      | 17.23                | 3.29  | 376        | 2881       | -60.17%                |
| 87   | 50  | 0.1      | 43.43                | 3989.07 | 0.21      | 18.16                | 2.59  | 333        | 3065       | -58.17%                |
| 88   | 50  | 0.1      | 18.08                | 3623.76 | 0.12      | 17.95                | 3.12  | 340        | 3210       | -0.73%                 |
| 89   | 50  | 0.1      | 20.40                | 3619.14 | 0.05      | 17.67                | 2.98  | 331        | 2960       | -13.40%                |
| 90   | 50  | 0.1      | 20.42                | 3622.31 | 0.78      | 17.86                | 2.93  | 303        | 3046       | -12.53%                |
| 91   | 50  | 0.1      | 19.03                | 3623.80 | 0.34      | 18.19                | 3.12  | 351        | 2957       | -4.42%                 |
| 92   | 50  | 0.1      | 18.65                | 3623.15 | 0.82      | 18.55                | 3.12  | 359        | 3172       | -0.52%                 |
| 93   | 50  | 0.1      | 18.55                | 3623.84 | 0.16      | 17.49                | 2.66  | 284        | 2813       | -5.67%                 |
| 94   | 50  | 0.1      | 45.44                | 4053.18 | 0.11      | 17.55                | 2.68  | 341        | 2762       | -61.37%                |
| 95   | 50  | 0.1      | 17.85                | 3624.75 | 0.60      | 17.42                | 2.92  | 256        | 3078       | -2.40%                 |
| 96   | 50  | 0.1      | 20.26                | 3617.77 | 0.12      | 19.87                | 3.26  | 366        | 3458       | -1.93%                 |
| 97   | 50  | 0.1      | 18.27                | 3629.96 | 0.39      | 17.79                | 2.88  | 273        | 2901       | -2.65%                 |
| 98   | 50  | 0.1      | 19.68                | 3621.90 | 0.15      | 17.77                | 2.98  | 338        | 2938       | -9.70%                 |
| 99   | 50  | 0.1      | 18.36                | 3616.26 | 0.32      | 18.24                | 3.23  | 300        | 3159       | -0.67%                 |
| 100  | 50  | 0.1      | 18.50                | 3609.72 | 0.39      | 18.45                | 3.54  | 353        | 3153       | -0.28%                 |
| 101  | 50  | 0.5      | 86.74                | 3605.90 | 0.16      | 43.23                | 42.85 | 1669       | 14604      | -50.17%                |
| 102  | 50  | 0.5      | 47.64                | 3621.85 | 0.11      | 46.81                | 48.62 | 1734       | 15285      | -1.73%                 |
| 103  | 50  | 0.5      | 45.88                | 3620.20 | 0.79      | 44.65                | 50.93 | 1658       | 15391      | -2.69%                 |
| 104  | 50  | 0.5      | 46.64                | 3627.14 | 0.19      | 45.52                | 51.05 | 1685       | 14733      | -2.39%                 |
| 105  | 50  | 0.5      | 43.32                | 3669.47 | 0.08      | 42.53                | 43.14 | 1554       | 14308      | -1.84%                 |
| 106  | 50  | 0.5      | 45.20                | 3642.91 | 0.23      | 43.38                | 49.40 | 1659       | 14426      | -4.02%                 |
| 107  | 50  | 0.5      | 45.70                | 3668.60 | 0.14      | 44.98                | 46.40 | 1571       | 15283      | -1.57%                 |
| 108  | 50  | 0.5      | 90.17                | 4052.75 | 0.30      | 44.63                | 49.04 | 1613       | 15192      | -50.51%                |
| 109  | 50  | 0.5      | 44.40                | 3645.66 | 0.32      | 44.13                | 48.50 | 1593       | 14548      | -0.60%                 |
| 110  | 50  | 0.5      | 47.42                | 3650.40 | 0.23      | 45.99                | 50.39 | 1562       | 15334      | -3.01%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|--------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 111  | 50  | 0.5      | 84.82                | 3623.50 | 0.19      | 43.27                | 40.26  | 1552       | 14281      | -48.98%                |
| 112  | 50  | 0.5      | 85.78                | 3619.58 | 0.19      | 43.43                | 39.09  | 1494       | 14417      | -49.37%                |
| 113  | 50  | 0.5      | 45.01                | 3644.29 | 0.20      | 44.62                | 51.34  | 1682       | 15301      | -0.87%                 |
| 114  | 50  | 0.5      | 45.57                | 3643.95 | 0.10      | 44.30                | 45.08  | 1469       | 14465      | -2.78%                 |
| 115  | 50  | 0.5      | 45.56                | 3643.58 | 0.81      | 45.46                | 49.48  | 1617       | 15460      | -0.23%                 |
| 116  | 50  | 0.5      | 45.79                | 3648.49 | 0.28      | 45.45                | 42.72  | 1577       | 14911      | -0.75%                 |
| 117  | 50  | 0.5      | 47.67                | 3647.74 | 0.31      | 45.94                | 55.58  | 1726       | 15442      | -3.62%                 |
| 118  | 50  | 0.5      | 88.20                | 4029.41 | 0.07      | 44.83                | 31.14  | 1646       | 15151      | -49.17%                |
| 119  | 50  | 0.5      | 91.36                | 3624.77 | 0.14      | 43.88                | 44.80  | 1680       | 14991      | -51.97%                |
| 120  | 50  | 0.5      | 42.78                | 3644.03 | 0.49      | 42.74                | 33.05  | 1499       | 14315      | -0.09%                 |
| 121  | 50  | 0.5      | 47.21                | 3627.63 | 0.18      | 46.11                | 50.81  | 1692       | 15526      | -2.33%                 |
| 122  | 50  | 0.5      | 44.76                | 3646.86 | 0.24      | 43.43                | 48.50  | 1662       | 14858      | -2.97%                 |
| 123  | 50  | 0.5      | 46.88                | 3638.27 | 0.25      | 46.27                | 48.93  | 1747       | 15616      | -1.31%                 |
| 124  | 50  | 0.5      | 44.99                | 3626.09 | 0.23      | 44.14                | 41.50  | 1600       | 14673      | -1.88%                 |
| 125  | 50  | 0.5      | 45.32                | 3619.02 | 0.33      | 43.25                | 45.06  | 1583       | 14459      | -4.57%                 |
| 126  | 50  | 2.0      | 87.01                | 3660.80 | 0.29      | 86.74                | 467.25 | 5297       | 48444      | -0.31%                 |
| 127  | 50  | 2.0      | 91.65                | 3742.81 | 0.08      | 91.03                | 529.30 | 5427       | 50727      | -0.67%                 |
| 128  | 50  | 2.0      | 87.17                | 3720.23 | 0.59      | 86.87                | 509.46 | 5365       | 48351      | -0.35%                 |
| 129  | 50  | 2.0      | 91.65                | 3806.36 | 0.26      | 90.24                | 594.20 | 5696       | 50038      | -1.54%                 |
| 130  | 50  | 2.0      | 83.80                | 4124.58 | 0.12      | 83.27                | 511.49 | 5084       | 46301      | -0.63%                 |
| 131  | 50  | 2.0      | 86.06                | 3846.18 | 0.16      | 84.55                | 520.72 | 5485       | 47993      | -1.76%                 |
| 132  | 50  | 2.0      | 88.91                | 3797.90 | 0.24      | 87.98                | 513.15 | 5471       | 49469      | -1.05%                 |
| 133  | 50  | 2.0      | 90.59                | 3650.09 | 0.19      | 90.17                | 524.14 | 5580       | 50026      | -0.46%                 |
| 134  | 50  | 2.0      | 85.03                | 4005.65 | 0.45      | 83.23                | 445.01 | 5138       | 45303      | -2.11%                 |
| 135  | 50  | 2.0      | 95.12                | 4096.08 | 0.06      | 94.21                | 537.40 | 5846       | 52312      | -0.96%                 |
| 136  | 50  | 2.0      | 85.27                | 3645.09 | 0.39      | 84.82                | 442.56 | 5183       | 46294      | -0.53%                 |
| 137  | 50  | 2.0      | 84.52                | 3648.72 | 0.22      | 83.79                | 503.76 | 5558       | 47304      | -0.86%                 |
| 138  | 50  | 2.0      | 91.58                | 4044.07 | 0.20      | 89.42                | 630.55 | 5716       | 50405      | -2.36%                 |
| 139  | 50  | 2.0      | 87.06                | 3948.95 | 0.03      | 86.39                | 474.36 | 5454       | 48125      | -0.77%                 |
| 140  | 50  | 2.0      | 90.40                | 4036.42 | 0.91      | 89.53                | 384.71 | 5358       | 49856      | -0.96%                 |
| 141  | 50  | 2.0      | 89.46                | 4012.63 | 0.31      | 87.53                | 471.20 | 6497       | 51278      | -2.16%                 |
| 142  | 50  | 2.0      | 89.92                | 4056.53 | 0.01      | 89.14                | 489.28 | 5439       | 49613      | -0.87%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|--------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 143  | 50  | 2.0      | 88.56                | 3652.33 | 0.15      | 87.89                | 462.27 | 5050       | 48560      | -0.76%                 |
| 144  | 50  | 2.0      | 92.10                | 3645.63 | 0.14      | 91.13                | 578.47 | 5806       | 51126      | -1.05%                 |
| 145  | 50  | 2.0      | 83.56                | 3980.05 | 0.51      | 83.24                | 430.14 | 5078       | 46211      | -0.38%                 |
| 146  | 50  | 2.0      | 92.39                | 3784.06 | 0.28      | 92.02                | 576.61 | 5781       | 52166      | -0.40%                 |
| 147  | 50  | 2.0      | 88.73                | 3818.03 | 0.40      | 87.20                | 556.91 | 5575       | 48379      | -1.73%                 |
| 148  | 50  | 2.0      | 94.38                | 3947.41 | 0.22      | 93.87                | 624.30 | 5734       | 52547      | -0.54%                 |
| 149  | 50  | 2.0      | 88.13                | 3772.46 | 0.32      | 88.05                | 514.46 | 5370       | 48483      | -0.10%                 |
| 150  | 50  | 2.0      | 85.12                | 3707.72 | 0.46      | 85.07                | 538.39 | 5207       | 47582      | -0.07%                 |
| 151  | 75  | 0.1      | 17.45                | 3606.90 | 0.20      | 17.04                | 4.25   | 294        | 2794       | -2.35%                 |
| 152  | 75  | 0.1      | 45.69                | 4018.50 | 0.18      | 17.41                | 5.56   | 335        | 3049       | -61.90%                |
| 153  | 75  | 0.1      | 19.72                | 3606.20 | 0.19      | 18.74                | 6.36   | 380        | 3088       | -4.99%                 |
| 154  | 75  | 0.1      | 19.56                | 3615.41 | 0.19      | 18.35                | 5.46   | 397        | 3116       | -6.20%                 |
| 155  | 75  | 0.1      | 44.14                | 3712.40 | 0.08      | 17.67                | 4.91   | 374        | 2985       | -59.96%                |
| 156  | 75  | 0.1      | 18.37                | 3615.45 | 0.47      | 17.60                | 4.52   | 331        | 3011       | -4.22%                 |
| 157  | 75  | 0.1      | 45.66                | 3732.92 | 0.23      | 17.57                | 4.47   | 306        | 2998       | -61.52%                |
| 158  | 75  | 0.1      | 17.44                | 3615.57 | 0.14      | 17.35                | 4.22   | 294        | 2877       | -0.53%                 |
| 159  | 75  | 0.1      | 17.88                | 3616.11 | 0.23      | 17.85                | 5.68   | 311        | 2960       | -0.18%                 |
| 160  | 75  | 0.1      | 19.33                | 3613.54 | 0.18      | 18.49                | 5.30   | 353        | 3132       | -4.34%                 |
| 161  | 75  | 0.1      | 19.23                | 3616.25 | 0.07      | 18.71                | 4.81   | 375        | 3158       | -2.73%                 |
| 162  | 75  | 0.1      | 17.99                | 3610.60 | 0.08      | 17.74                | 4.76   | 355        | 2976       | -1.41%                 |
| 163  | 75  | 0.1      | 17.61                | 3605.80 | 0.47      | 17.41                | 4.17   | 336        | 2884       | -1.16%                 |
| 164  | 75  | 0.1      | 44.57                | 3978.80 | 0.25      | 18.26                | 5.15   | 323        | 3047       | -59.03%                |
| 165  | 75  | 0.1      | 43.72                | 3723.88 | 0.20      | 18.58                | 4.82   | 341        | 3154       | -57.49%                |
| 166  | 75  | 0.1      | 19.11                | 3615.68 | 0.13      | 18.24                | 4.64   | 311        | 3139       | -4.58%                 |
| 167  | 75  | 0.1      | 18.95                | 3614.89 | 0.25      | 18.62                | 5.42   | 373        | 3201       | -1.73%                 |
| 168  | 75  | 0.1      | 17.76                | 3615.71 | 0.17      | 17.48                | 4.23   | 271        | 2819       | -1.58%                 |
| 169  | 75  | 0.1      | 45.85                | 3754.21 | 0.22      | 18.10                | 5.00   | 406        | 3297       | -60.51%                |
| 170  | 75  | 0.1      | 18.61                | 3615.36 | 0.17      | 18.13                | 4.45   | 334        | 3152       | -2.58%                 |
| 171  | 75  | 0.1      | 45.02                | 3738.69 | 0.27      | 18.05                | 4.51   | 307        | 3110       | -59.89%                |
| 172  | 75  | 0.1      | 18.47                | 3615.15 | 0.23      | 18.28                | 4.41   | 334        | 3048       | -1.00%                 |
| 173  | 75  | 0.1      | 19.01                | 3614.02 | 0.09      | 17.19                | 4.48   | 354        | 2923       | -9.57%                 |
| 174  | 75  | 0.1      | 17.64                | 3616.30 | 0.13      | 16.16                | 4.59   | 316        | 2704       | -8.38%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|--------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 175  | 75  | 0.1      | 19.72                | 3623.43 | 0.11      | 18.91                | 5.14   | 371        | 3167       | -4.12%                 |
| 176  | 75  | 0.5      | 44.83                | 3665.10 | 0.19      | 44.75                | 54.99  | 1627       | 14736      | -0.18%                 |
| 177  | 75  | 0.5      | 92.00                | 3605.70 | 0.17      | 45.69                | 62.44  | 1577       | 15288      | -50.34%                |
| 178  | 75  | 0.5      | 46.82                | 3670.30 | 0.19      | 46.37                | 68.38  | 1776       | 15481      | -0.95%                 |
| 179  | 75  | 0.5      | 44.93                | 3625.83 | 0.18      | 44.58                | 61.73  | 1656       | 14746      | -0.79%                 |
| 180  | 75  | 0.5      | 44.80                | 3607.30 | 0.18      | 44.09                | 57.76  | 1666       | 14869      | -1.58%                 |
| 181  | 75  | 0.5      | 46.41                | 3626.65 | 0.34      | 45.21                | 61.31  | 1567       | 15200      | -2.58%                 |
| 182  | 75  | 0.5      | 89.22                | 3614.02 | 0.22      | 45.65                | 58.86  | 1652       | 15037      | -48.84%                |
| 183  | 75  | 0.5      | 44.47                | 3626.84 | 0.18      | 43.54                | 57.13  | 1615       | 14205      | -2.09%                 |
| 184  | 75  | 0.5      | 44.67                | 3626.06 | 0.18      | 44.58                | 54.03  | 1634       | 15094      | -0.21%                 |
| 185  | 75  | 0.5      | 46.08                | 3624.66 | 0.03      | 44.32                | 48.95  | 1679       | 14916      | -3.82%                 |
| 186  | 75  | 0.5      | 46.81                | 3626.13 | 0.12      | 45.64                | 58.39  | 1635       | 15487      | -2.49%                 |
| 187  | 75  | 0.5      | 45.90                | 3631.30 | 0.09      | 45.22                | 44.34  | 1716       | 14954      | -1.49%                 |
| 188  | 75  | 0.5      | 43.65                | 3620.10 | 0.26      | 43.31                | 53.88  | 1552       | 14755      | -0.77%                 |
| 189  | 75  | 0.5      | 88.24                | 3609.70 | 0.23      | 44.57                | 63.34  | 1683       | 14772      | -49.49%                |
| 190  | 75  | 0.5      | 87.26                | 3615.09 | 0.20      | 43.72                | 46.02  | 1691       | 14710      | -49.90%                |
| 191  | 75  | 0.5      | 45.75                | 3625.98 | 0.16      | 45.14                | 51.72  | 1606       | 15116      | -1.33%                 |
| 192  | 75  | 0.5      | 89.09                | 3729.23 | 0.17      | 45.86                | 52.47  | 1615       | 15348      | -48.52%                |
| 193  | 75  | 0.5      | 44.46                | 3625.73 | 0.16      | 44.32                | 53.39  | 1643       | 14640      | -0.32%                 |
| 194  | 75  | 0.5      | 89.36                | 3616.54 | 0.23      | 45.85                | 66.99  | 1812       | 15773      | -48.70%                |
| 195  | 75  | 0.5      | 45.49                | 3626.31 | 0.14      | 45.29                | 57.18  | 1605       | 15048      | -0.44%                 |
| 196  | 75  | 0.5      | 88.76                | 3615.08 | 0.88      | 45.02                | 46.54  | 1526       | 14854      | -49.28%                |
| 197  | 75  | 0.5      | 44.53                | 3624.52 | 0.15      | 44.29                | 40.32  | 1643       | 14621      | -0.52%                 |
| 198  | 75  | 0.5      | 46.75                | 3624.74 | 0.08      | 45.83                | 53.43  | 1758       | 15295      | -1.97%                 |
| 199  | 75  | 0.5      | 84.86                | 3721.12 | 0.07      | 43.45                | 47.45  | 1520       | 14662      | -48.80%                |
| 200  | 75  | 0.5      | 47.34                | 3633.66 | 0.10      | 46.90                | 64.89  | 1717       | 15806      | -0.92%                 |
| 201  | 75  | 2.0      | 87.45                | 3809.00 | 0.35      | 86.82                | 493.50 | 5275       | 47741      | -0.72%                 |
| 202  | 75  | 2.0      | 92.65                | 3645.50 | 0.17      | 91.84                | 641.25 | 5427       | 52552      | -0.88%                 |
| 203  | 75  | 2.0      | 90.81                | 4060.70 | 0.16      | 90.20                | 684.60 | 5702       | 50871      | -0.67%                 |
| 204  | 75  | 2.0      | 87.51                | 3728.00 | 0.19      | 86.91                | 537.13 | 5315       | 47441      | -0.68%                 |
| 205  | 75  | 2.0      | 87.92                | 4086.60 | 0.13      | 87.44                | 583.15 | 5642       | 49670      | -0.54%                 |
| 206  | 75  | 2.0      | 88.70                | 3728.05 | 0.19      | 88.19                | 563.32 | 5686       | 49278      | -0.57%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|--------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 207  | 75  | 2.0      | 88.70                | 3626.84 | 0.20      | 87.97                | 539.24 | 5293       | 50037      | -0.83%                 |
| 208  | 75  | 2.0      | 86.34                | 3748.83 | 0.14      | 84.95                | 593.23 | 5228       | 47321      | -1.61%                 |
| 209  | 75  | 2.0      | 86.80                | 3737.31 | 0.32      | 85.22                | 600.64 | 5107       | 48074      | -1.82%                 |
| 210  | 75  | 2.0      | 88.66                | 3731.27 | 0.18      | 87.59                | 636.23 | 5337       | 49343      | -1.21%                 |
| 211  | 75  | 2.0      | 91.79                | 3742.84 | 0.09      | 91.17                | 690.30 | 5732       | 52049      | -0.67%                 |
| 212  | 75  | 2.0      | 90.28                | 4104.80 | 0.27      | 89.15                | 745.33 | 6322       | 50721      | -1.26%                 |
| 213  | 75  | 2.0      | 86.92                | 4364.50 | 0.25      | 85.50                | 568.64 | 5113       | 48856      | -1.63%                 |
| 214  | 75  | 2.0      | 86.89                | 3742.80 | 0.07      | 86.13                | 557.31 | 5721       | 49494      | -0.88%                 |
| 215  | 75  | 2.0      | 87.42                | 3624.47 | 0.15      | 87.26                | 602.41 | 5501       | 49551      | -0.18%                 |
| 216  | 75  | 2.0      | 88.08                | 3735.99 | 0.18      | 87.96                | 564.57 | 5321       | 48373      | -0.14%                 |
| 217  | 75  | 2.0      | 89.27                | 3625.88 | 0.34      | 88.39                | 664.75 | 5652       | 48873      | -0.98%                 |
| 218  | 75  | 2.0      | 88.59                | 3737.52 | 0.33      | 86.43                | 607.93 | 5350       | 48388      | -2.43%                 |
| 219  | 75  | 2.0      | 89.95                | 3629.29 | 0.13      | 89.36                | 267.64 | 5639       | 50191      | -0.65%                 |
| 220  | 75  | 2.0      | 91.06                | 3743.85 | 0.16      | 89.23                | 637.18 | 5433       | 49317      | -2.01%                 |
| 221  | 75  | 2.0      | 86.96                | 3625.73 | 0.16      | 86.04                | 552.72 | 5360       | 49796      | -1.05%                 |
| 222  | 75  | 2.0      | 87.73                | 3732.00 | 0.24      | 86.35                | 586.00 | 5441       | 48935      | -1.57%                 |
| 223  | 75  | 2.0      | 91.55                | 3740.45 | 0.10      | 90.16                | 594.08 | 5788       | 50870      | -1.52%                 |
| 224  | 75  | 2.0      | 83.79                | 3626.57 | 0.17      | 82.98                | 558.92 | 5171       | 47061      | -0.97%                 |
| 225  | 75  | 2.0      | 93.15                | 3783.96 | 0.21      | 92.25                | 777.65 | 5700       | 51659      | -0.97%                 |
| 226  | 100 | 0.1      | 90.65                | 3622.20 | 0.10      | 18.48                | 6.32   | 350        | 3127       | -79.62%                |
| 227  | 100 | 0.1      | 18.69                | 3693.47 | 0.10      | 17.20                | 5.67   | 323        | 2900       | -7.96%                 |
| 228  | 100 | 0.1      | 44.94                | 4177.40 | 0.11      | 18.19                | 5.18   | 339        | 3050       | -59.52%                |
| 229  | 100 | 0.1      | 19.35                | 3692.54 | 0.15      | 17.23                | 5.26   | 333        | 2878       | -10.95%                |
| 230  | 100 | 0.1      | 18.88                | 3701.43 | 0.12      | 16.87                | 5.69   | 331        | 2963       | -10.64%                |
| 231  | 100 | 0.1      | 18.82                | 3689.92 | 0.04      | 17.97                | 5.34   | 322        | 2941       | -4.53%                 |
| 232  | 100 | 0.1      | 18.32                | 3693.98 | 0.76      | 17.69                | 5.86   | 345        | 3025       | -3.41%                 |
| 233  | 100 | 0.1      | 44.33                | 4284.02 | 0.54      | 17.31                | 5.84   | 357        | 3021       | -60.96%                |
| 234  | 100 | 0.1      | 45.60                | 4308.74 | 0.12      | 18.43                | 5.30   | 336        | 3010       | -59.58%                |
| 235  | 100 | 0.1      | 44.88                | 3736.23 | 0.31      | 18.11                | 5.49   | 388        | 3234       | -59.65%                |
| 236  | 100 | 0.1      | 19.05                | 3605.10 | 0.15      | 17.84                | 5.14   | 319        | 3001       | -6.38%                 |
| 237  | 100 | 0.1      | 86.94                | 3740.43 | 0.09      | 17.34                | 5.83   | 291        | 2869       | -80.05%                |
| 238  | 100 | 0.1      | 90.94                | 3674.20 | 0.18      | 19.29                | 6.13   | 391        | 3295       | -78.79%                |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-VaR |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|-----------|----------------------|-------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)    | D-RPD     | V-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 239  | 100 | 0.1      | 18.93                | 3685.80 | 0.09      | 18.35                | 5.44  | 375        | 3182       | -3.06%                 |
| 240  | 100 | 0.1      | 88.22                | 3676.80 | 0.10      | 17.96                | 5.15  | 295        | 2971       | -79.64%                |
| 241  | 100 | 0.1      | 46.09                | 4425.62 | 0.06      | 17.93                | 5.12  | 311        | 3056       | -61.10%                |
| 242  | 100 | 0.1      | 45.50                | 4317.80 | 0.16      | 18.60                | 5.67  | 362        | 3168       | -59.12%                |
| 243  | 100 | 0.1      | 19.10                | 3691.62 | 0.16      | 18.12                | 5.12  | 259        | 2880       | -5.08%                 |
| 244  | 100 | 0.1      | 18.47                | 3608.00 | 0.13      | 18.00                | 5.55  | 354        | 3068       | -2.57%                 |
| 245  | 100 | 0.1      | 20.51                | 3694.13 | 0.05      | 17.59                | 5.10  | 257        | 3022       | -14.22%                |
| 246  | 100 | 0.1      | 18.60                | 3611.20 | 0.05      | 18.04                | 4.93  | 332        | 2937       | -3.01%                 |
| 247  | 100 | 0.1      | 18.34                | 3615.60 | 0.09      | 17.09                | 5.39  | 332        | 2944       | -6.82%                 |
| 248  | 100 | 0.1      | 19.88                | 3608.94 | 0.62      | 17.83                | 5.77  | 303        | 3041       | -10.31%                |
| 249  | 100 | 0.1      | 17.88                | 3611.90 | 0.70      | 16.83                | 4.88  | 340        | 2923       | -5.91%                 |
| 250  | 100 | 0.1      | 19.12                | 3615.60 | 0.16      | 17.93                | 5.56  | 333        | 3087       | -6.20%                 |
| 251  | 100 | 0.5      | 47.23                | 4379.00 | 0.09      | 46.39                | 58.58 | 1765       | 15681      | -1.78%                 |
| 252  | 100 | 0.5      | 45.52                | 3736.54 | 0.07      | 44.50                | 59.18 | 1763       | 14886      | -2.25%                 |
| 253  | 100 | 0.5      | 88.27                | 3611.10 | 0.15      | 44.94                | 53.09 | 1608       | 14893      | -49.09%                |
| 254  | 100 | 0.5      | 44.83                | 3729.63 | 0.08      | 44.56                | 52.29 | 1735       | 15014      | -0.59%                 |
| 255  | 100 | 0.5      | 44.85                | 3744.79 | 0.08      | 44.71                | 55.18 | 1670       | 14804      | -0.30%                 |
| 256  | 100 | 0.5      | 45.28                | 3729.32 | 0.08      | 45.21                | 54.01 | 1623       | 14869      | -0.16%                 |
| 257  | 100 | 0.5      | 46.39                | 3732.47 | 0.66      | 45.47                | 60.09 | 1758       | 15342      | -1.98%                 |
| 258  | 100 | 0.5      | 86.08                | 3691.56 | 0.60      | 44.33                | 58.59 | 1720       | 15018      | -48.51%                |
| 259  | 100 | 0.5      | 88.88                | 3689.87 | 0.23      | 45.60                | 61.45 | 1772       | 15068      | -48.70%                |
| 260  | 100 | 0.5      | 45.01                | 3688.63 | 0.23      | 44.37                | 58.52 | 1733       | 14892      | -1.43%                 |
| 261  | 100 | 0.5      | 47.58                | 3722.30 | 0.17      | 47.43                | 78.49 | 1874       | 16123      | -0.30%                 |
| 262  | 100 | 0.5      | 44.80                | 4303.91 | 0.77      | 44.23                | 56.92 | 1570       | 14549      | -1.29%                 |
| 263  | 100 | 0.5      | 46.50                | 4234.90 | 0.15      | 46.13                | 65.98 | 1658       | 15541      | -0.80%                 |
| 264  | 100 | 0.5      | 45.97                | 3736.39 | 0.11      | 45.52                | 58.72 | 1778       | 15356      | -0.98%                 |
| 265  | 100 | 0.5      | 44.55                | 3868.80 | 0.04      | 44.54                | 52.73 | 1635       | 14971      | -0.03%                 |
| 266  | 100 | 0.5      | 91.96                | 3693.67 | 0.09      | 46.09                | 68.99 | 1757       | 15372      | -49.88%                |
| 267  | 100 | 0.5      | 87.60                | 3611.00 | 0.10      | 45.38                | 65.52 | 1639       | 15211      | -48.19%                |
| 268  | 100 | 0.5      | 46.56                | 3738.43 | 0.11      | 46.25                | 57.99 | 1765       | 15484      | -0.68%                 |
| 269  | 100 | 0.5      | 46.05                | 3725.90 | 0.28      | 45.40                | 60.09 | 1635       | 15331      | -1.43%                 |
| 270  | 100 | 0.5      | 46.69                | 3742.27 | 0.15      | 46.47                | 67.73 | 1618       | 15520      | -0.46%                 |

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Table 2: Result of SimExact X SimSA-VaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |          | SimSA-VaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|----------|-----------|----------------------|--------|------------|------------|------------------------|
|      |     |          | V-RPD <sup>(a)</sup> | T(s)     | D-RPD     | V-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 271  | 100 | 0.5      | 46.32                | 3646.30  | 0.12      | 46.05                | 61.03  | 1660       | 15143      | -0.58%                 |
| 272  | 100 | 0.5      | 86.65                | 11024.40 | 0.11      | 44.71                | 53.53  | 1735       | 15087      | -48.40%                |
| 273  | 100 | 0.5      | 47.34                | 3637.80  | 0.54      | 46.35                | 64.97  | 1684       | 15502      | -2.10%                 |
| 274  | 100 | 0.5      | 44.80                | 3653.90  | 0.34      | 44.72                | 61.16  | 1573       | 14788      | -0.20%                 |
| 275  | 100 | 0.5      | 45.38                | 3660.50  | 0.06      | 45.10                | 57.20  | 1679       | 15074      | -0.62%                 |
| 276  | 100 | 2.0      | 90.73                | 3604.00  | 0.06      | 90.65                | 615.36 | 5613       | 50446      | -0.09%                 |
| 277  | 100 | 2.0      | 87.83                | 4350.05  | 0.18      | 86.81                | 582.74 | 5302       | 48753      | -1.17%                 |
| 278  | 100 | 2.0      | 86.85                | 3742.40  | 0.16      | 85.99                | 551.26 | 5563       | 48764      | -0.99%                 |
| 279  | 100 | 2.0      | 87.62                | 4314.04  | 0.25      | 87.60                | 569.99 | 5507       | 49812      | -0.02%                 |
| 280  | 100 | 2.0      | 85.71                | 4289.95  | 0.00      | 84.66                | 508.94 | 5391       | 48027      | -1.23%                 |
| 281  | 100 | 2.0      | 87.40                | 4312.90  | 0.21      | 86.99                | 622.38 | 5357       | 48299      | -0.46%                 |
| 282  | 100 | 2.0      | 88.23                | 4339.81  | 0.60      | 88.10                | 625.62 | 5433       | 49473      | -0.15%                 |
| 283  | 100 | 2.0      | 86.37                | 3736.75  | 0.71      | 86.08                | 606.90 | 5612       | 48571      | -0.33%                 |
| 284  | 100 | 2.0      | 88.60                | 3737.38  | 0.17      | 87.78                | 593.95 | 5317       | 49467      | -0.92%                 |
| 285  | 100 | 2.0      | 86.99                | 4302.11  | 0.24      | 85.63                | 501.07 | 5438       | 47315      | -1.56%                 |
| 286  | 100 | 2.0      | 94.17                | 3803.20  | 0.17      | 93.96                | 766.93 | 6009       | 53910      | -0.23%                 |
| 287  | 100 | 2.0      | 87.72                | 3689.67  | 0.70      | 86.85                | 596.05 | 5192       | 48768      | -1.00%                 |
| 288  | 100 | 2.0      | 88.85                | 3609.40  | 0.12      | 87.97                | 656.32 | 5496       | 51275      | -0.98%                 |
| 289  | 100 | 2.0      | 86.22                | 4323.21  | 0.03      | 86.17                | 637.78 | 5330       | 50215      | -0.06%                 |
| 290  | 100 | 2.0      | 87.37                | 3609.30  | 0.16      | 86.67                | 550.98 | 5675       | 49571      | -0.80%                 |
| 291  | 100 | 2.0      | 90.88                | 3738.96  | 0.06      | 89.91                | 663.24 | 5725       | 51255      | -1.07%                 |
| 292  | 100 | 2.0      | 88.41                | 3668.60  | 0.09      | 87.51                | 550.66 | 5392       | 48894      | -1.02%                 |
| 293  | 100 | 2.0      | 88.36                | 4351.22  | 0.01      | 88.14                | 637.28 | 5710       | 49713      | -0.25%                 |
| 294  | 100 | 2.0      | 89.09                | 3835.40  | 0.23      | 88.81                | 549.72 | 5808       | 49672      | -0.30%                 |
| 295  | 100 | 2.0      | 89.51                | 4349.52  | 0.15      | 89.03                | 623.46 | 5672       | 50799      | -0.53%                 |
| 296  | 100 | 2.0      | 90.64                | 4244.40  | 0.13      | 88.68                | 609.56 | 5563       | 50656      | -2.17%                 |
| 297  | 100 | 2.0      | 85.81                | 3632.40  | 0.28      | 85.04                | 485.82 | 5460       | 48133      | -0.91%                 |
| 298  | 100 | 2.0      | 91.67                | 4134.42  | 0.72      | 89.29                | 573.78 | 5923       | 51503      | -2.59%                 |
| 299  | 100 | 2.0      | 86.44                | 11021.80 | 0.30      | 85.24                | 507.14 | 5303       | 48295      | -1.39%                 |
| 300  | 100 | 2.0      | 85.14                | 4045.80  | 0.66      | 84.85                | 580.48 | 5430       | 47682      | -0.34%                 |

### 3. SimSA-CVaR X SimExact

Table 3: Result of SimExact x SimSA-CVaR

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|-------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 1    | 25  | 0.1      | 19.10                | 200.30  | 0.44       | 18.09                | 8.06  | 356        | 3307       | -5.29%                 |
| 2    | 25  | 0.1      | 21.31                | 187.00  | 1.04       | 18.03                | 2.60  | 337        | 3014       | -15.42%                |
| 3    | 25  | 0.1      | 22.17                | 134.10  | 0.20       | 20.62                | 2.45  | 411        | 3699       | -6.98%                 |
| 4    | 25  | 0.1      | 21.27                | 374.80  | 0.60       | 20.32                | 1.92  | 346        | 3245       | -4.46%                 |
| 5    | 25  | 0.1      | 18.90                | 265.40  | 0.64       | 18.56                | 2.30  | 363        | 3038       | -1.83%                 |
| 6    | 25  | 0.1      | 20.96                | 228.40  | 0.50       | 19.55                | 2.26  | 354        | 3304       | -6.73%                 |
| 7    | 25  | 0.1      | 21.85                | 3604.91 | 0.23       | 16.53                | 1.75  | 314        | 2905       | -24.37%                |
| 8    | 25  | 0.1      | 20.94                | 381.00  | 0.29       | 18.74                | 1.81  | 292        | 3041       | -10.52%                |
| 9    | 25  | 0.1      | 19.47                | 346.40  | 0.35       | 17.92                | 2.13  | 379        | 3034       | -7.97%                 |
| 10   | 25  | 0.1      | 21.68                | 265.20  | 0.54       | 20.36                | 2.39  | 372        | 3268       | -6.09%                 |
| 11   | 25  | 0.1      | 22.92                | 366.60  | 0.44       | 18.26                | 2.24  | 345        | 3139       | -20.32%                |
| 12   | 25  | 0.1      | 22.92                | 168.70  | 0.36       | 17.29                | 1.84  | 342        | 2969       | -24.55%                |
| 13   | 25  | 0.1      | 19.68                | 285.30  | 0.94       | 16.99                | 1.62  | 286        | 2683       | -13.64%                |
| 14   | 25  | 0.1      | 20.79                | 342.60  | 0.34       | 19.88                | 2.93  | 357        | 3261       | -4.35%                 |
| 15   | 25  | 0.1      | 17.96                | 257.20  | 0.81       | 17.81                | 1.93  | 332        | 2935       | -0.85%                 |
| 16   | 25  | 0.1      | 22.03                | 391.40  | 0.37       | 18.26                | 2.57  | 348        | 2874       | -17.10%                |
| 17   | 25  | 0.1      | 23.30                | 243.80  | 0.47       | 18.14                | 1.71  | 341        | 2968       | -22.14%                |
| 18   | 25  | 0.1      | 19.57                | 218.00  | 0.36       | 18.07                | 3.20  | 411        | 3425       | -7.64%                 |
| 19   | 25  | 0.1      | 46.89                | 638.00  | 0.17       | 18.06                | 2.23  | 374        | 3106       | -61.49%                |
| 20   | 25  | 0.1      | 18.74                | 368.10  | 0.32       | 17.88                | 2.68  | 338        | 2980       | -4.60%                 |
| 21   | 25  | 0.1      | 18.03                | 3607.43 | 0.59       | 17.37                | 2.41  | 332        | 2945       | -3.67%                 |
| 22   | 25  | 0.1      | 53.88                | 1070.50 | 0.36       | 21.32                | 3.26  | 394        | 3513       | -60.43%                |
| 23   | 25  | 0.1      | 19.78                | 318.30  | 0.59       | 16.43                | 2.45  | 311        | 2940       | -16.96%                |
| 24   | 25  | 0.1      | 21.06                | 194.20  | 0.47       | 17.69                | 1.99  | 300        | 2928       | -16.00%                |
| 25   | 25  | 0.1      | 19.30                | 359.70  | 0.81       | 17.23                | 2.46  | 347        | 2880       | -10.74%                |
| 26   | 25  | 0.5      | 44.11                | 342.30  | 1.07       | 42.51                | 27.81 | 1576       | 13729      | -3.63%                 |
| 27   | 25  | 0.5      | 50.24                | 214.00  | 0.78       | 45.76                | 40.74 | 1739       | 15419      | -8.91%                 |
| 28   | 25  | 0.5      | 48.03                | 240.50  | 0.19       | 47.73                | 38.86 | 1805       | 16295      | -0.63%                 |
| 29   | 25  | 0.5      | 47.70                | 458.20  | 0.60       | 44.40                | 36.91 | 1693       | 14606      | -6.90%                 |
| 30   | 25  | 0.5      | 43.25                | 276.10  | 0.41       | 42.99                | 32.88 | 1519       | 14310      | -0.60%                 |
| 31   | 25  | 0.5      | 46.31                | 297.40  | 0.30       | 46.25                | 36.45 | 1747       | 15078      | -0.13%                 |
| 32   | 25  | 0.5      | 43.80                | 3617.21 | 0.17       | 41.04                | 27.67 | 1531       | 13618      | -6.30%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |         |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|---------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)    | # $\rho_S$ | # $\rho_L$ |                        |
| 33   | 25  | 0.5      | 48.01                | 460.90  | 1.20       | 44.86                | 40.77   | 1755       | 15768      | -6.55%                 |
| 34   | 25  | 0.5      | 45.77                | 432.30  | 0.73       | 42.41                | 39.75   | 1595       | 14212      | -7.35%                 |
| 35   | 25  | 0.5      | 49.53                | 400.40  | 1.02       | 46.38                | 42.55   | 1586       | 14919      | -6.35%                 |
| 36   | 25  | 0.5      | 45.54                | 450.80  | 0.47       | 43.93                | 40.23   | 1719       | 14973      | -3.54%                 |
| 37   | 25  | 0.5      | 47.01                | 266.10  | 0.47       | 44.66                | 17.29   | 1632       | 14992      | -5.00%                 |
| 38   | 25  | 0.5      | 45.63                | 291.30  | 0.65       | 44.75                | 33.20   | 1694       | 14730      | -1.93%                 |
| 39   | 25  | 0.5      | 53.83                | 432.00  | 1.26       | 52.67                | 76.09   | 2160       | 19321      | -2.16%                 |
| 40   | 25  | 0.5      | 45.28                | 325.90  | 0.00       | 43.42                | 32.65   | 1632       | 14822      | -4.09%                 |
| 41   | 25  | 0.5      | 49.58                | 467.20  | 0.24       | 49.48                | 46.62   | 1891       | 16830      | -0.20%                 |
| 42   | 25  | 0.5      | 48.01                | 309.70  | 0.93       | 44.91                | 39.77   | 1613       | 14430      | -6.47%                 |
| 43   | 25  | 0.5      | 46.57                | 252.40  | 0.29       | 45.79                | 41.26   | 1792       | 15340      | -1.67%                 |
| 44   | 25  | 0.5      | 90.73                | 243.20  | 0.25       | 45.24                | 39.49   | 1669       | 15602      | -50.13%                |
| 45   | 25  | 0.5      | 42.22                | 380.20  | 0.47       | 41.49                | 37.17   | 1614       | 14052      | -1.74%                 |
| 46   | 25  | 0.5      | 44.07                | 3626.84 | 0.79       | 43.06                | 32.03   | 1625       | 13784      | -2.30%                 |
| 47   | 25  | 0.5      | 115.70               | 307.60  | 0.80       | 53.88                | 71.51   | 1954       | 18099      | -53.43%                |
| 48   | 25  | 0.5      | 44.56                | 415.30  | 0.17       | 43.35                | 41.04   | 1605       | 14600      | -2.72%                 |
| 49   | 25  | 0.5      | 47.67                | 222.50  | 1.03       | 42.77                | 43.07   | 1508       | 14084      | -10.27%                |
| 50   | 25  | 0.5      | 44.37                | 367.70  | 1.03       | 44.21                | 41.99   | 1596       | 14034      | -0.34%                 |
| 51   | 25  | 2.0      | 86.96                | 915.20  | 0.27       | 85.52                | 362.27  | 5081       | 46399      | -1.66%                 |
| 52   | 25  | 2.0      | 92.69                | 791.40  | 0.88       | 91.74                | 486.80  | 5711       | 51099      | -1.03%                 |
| 53   | 25  | 2.0      | 91.23                | 441.10  | 0.63       | 88.21                | 451.42  | 5411       | 49240      | -3.31%                 |
| 54   | 25  | 2.0      | 90.63                | 828.80  | 0.61       | 86.19                | 377.38  | 5332       | 46863      | -4.89%                 |
| 55   | 25  | 2.0      | 87.91                | 850.70  | 0.38       | 85.54                | 445.75  | 5234       | 46282      | -2.70%                 |
| 56   | 25  | 2.0      | 90.33                | 974.90  | 0.71       | 89.76                | 454.33  | 5385       | 49253      | -0.63%                 |
| 57   | 25  | 2.0      | 84.74                | 3770.04 | 0.44       | 82.22                | 413.85  | 5047       | 45284      | -2.97%                 |
| 58   | 25  | 2.0      | 89.88                | 1099.90 | 1.65       | 88.21                | 491.79  | 5572       | 49611      | -1.85%                 |
| 59   | 25  | 2.0      | 85.94                | 777.40  | 0.43       | 85.88                | 409.47  | 5454       | 47773      | -0.07%                 |
| 60   | 25  | 2.0      | 89.82                | 751.20  | 0.89       | 89.38                | 405.55  | 5314       | 48055      | -0.49%                 |
| 61   | 25  | 2.0      | 88.05                | 630.90  | 0.35       | 86.31                | 420.67  | 5301       | 48334      | -1.98%                 |
| 62   | 25  | 2.0      | 89.08                | 904.60  | 0.90       | 87.77                | 459.10  | 5337       | 48127      | -1.47%                 |
| 63   | 25  | 2.0      | 89.73                | 584.70  | 1.08       | 89.12                | 389.23  | 5143       | 47567      | -0.68%                 |
| 64   | 25  | 2.0      | 116.19               | 616.70  | 1.03       | 111.71               | 1053.66 | 7789       | 68871      | -3.86%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 65   | 25  | 2.0      | 92.45                | 640.90  | 1.25       | 92.05                | 580.14 | 6042       | 52756      | -0.44%                 |
| 66   | 25  | 2.0      | 101.54               | 607.20  | 0.22       | 101.14               | 588.01 | 6359       | 58268      | -0.39%                 |
| 67   | 25  | 2.0      | 89.11                | 710.20  | 0.42       | 86.53                | 368.91 | 5390       | 47189      | -2.89%                 |
| 68   | 25  | 2.0      | 93.35                | 813.00  | 0.22       | 93.31                | 497.16 | 5637       | 51253      | -0.04%                 |
| 69   | 25  | 2.0      | 91.06                | 359.20  | 0.27       | 90.26                | 476.84 | 5436       | 49283      | -0.87%                 |
| 70   | 25  | 2.0      | 83.23                | 879.60  | 0.16       | 81.95                | 321.88 | 5087       | 45608      | -1.54%                 |
| 71   | 25  | 2.0      | 84.00                | 3844.08 | 0.64       | 82.06                | 288.66 | 4632       | 44784      | -2.31%                 |
| 72   | 25  | 2.0      | 115.91               | 405.10  | 0.14       | 114.59               | 965.39 | 7332       | 69347      | -1.14%                 |
| 73   | 25  | 2.0      | 87.78                | 882.40  | 0.39       | 85.99                | 488.24 | 5476       | 48375      | -2.05%                 |
| 74   | 25  | 2.0      | 88.16                | 937.60  | 0.63       | 87.10                | 463.23 | 5292       | 47667      | -1.20%                 |
| 75   | 25  | 2.0      | 84.55                | 765.90  | 0.56       | 84.49                | 426.70 | 5079       | 45848      | -0.07%                 |
| 76   | 50  | 0.1      | 44.53                | 4289.80 | 0.24       | 17.61                | 3.71   | 374        | 3035       | -60.47%                |
| 77   | 50  | 0.1      | 19.28                | 3611.12 | 0.11       | 19.07                | 3.71   | 353        | 3371       | -1.08%                 |
| 78   | 50  | 0.1      | 19.71                | 3610.67 | 0.09       | 18.74                | 3.56   | 321        | 3381       | -4.93%                 |
| 79   | 50  | 0.1      | 20.50                | 3617.11 | 0.12       | 17.90                | 3.55   | 347        | 2965       | -12.73%                |
| 80   | 50  | 0.1      | 17.69                | 3636.41 | 0.04       | 16.98                | 3.61   | 337        | 3056       | -4.03%                 |
| 81   | 50  | 0.1      | 19.86                | 3621.79 | 0.15       | 16.92                | 3.92   | 379        | 3023       | -14.80%                |
| 82   | 50  | 0.1      | 18.19                | 3611.40 | 0.25       | 17.74                | 3.39   | 319        | 3121       | -2.46%                 |
| 83   | 50  | 0.1      | 18.29                | 3623.80 | 0.29       | 18.19                | 3.58   | 320        | 3184       | -0.56%                 |
| 84   | 50  | 0.1      | 18.18                | 3623.38 | 0.38       | 17.60                | 3.84   | 350        | 3083       | -3.20%                 |
| 85   | 50  | 0.1      | 20.39                | 3624.27 | 0.17       | 17.87                | 3.76   | 320        | 2939       | -12.32%                |
| 86   | 50  | 0.1      | 43.27                | 3999.92 | 0.19       | 17.23                | 3.29   | 376        | 2881       | -60.17%                |
| 87   | 50  | 0.1      | 43.43                | 3989.07 | 0.21       | 18.16                | 2.59   | 333        | 3065       | -58.17%                |
| 88   | 50  | 0.1      | 18.08                | 3623.76 | 0.12       | 17.95                | 3.12   | 340        | 3210       | -0.73%                 |
| 89   | 50  | 0.1      | 20.40                | 3619.14 | 0.05       | 17.67                | 2.98   | 331        | 2960       | -13.40%                |
| 90   | 50  | 0.1      | 20.42                | 3622.31 | 0.78       | 17.86                | 2.93   | 303        | 3046       | -12.53%                |
| 91   | 50  | 0.1      | 19.03                | 3623.80 | 0.34       | 18.19                | 3.12   | 351        | 2957       | -4.42%                 |
| 92   | 50  | 0.1      | 18.65                | 3623.15 | 0.82       | 18.55                | 3.12   | 359        | 3172       | -0.52%                 |
| 93   | 50  | 0.1      | 18.55                | 3623.84 | 0.16       | 17.49                | 2.66   | 284        | 2813       | -5.67%                 |
| 94   | 50  | 0.1      | 45.44                | 4053.18 | 0.11       | 17.55                | 2.68   | 341        | 2762       | -61.37%                |
| 95   | 50  | 0.1      | 17.85                | 3624.75 | 0.60       | 17.42                | 2.92   | 256        | 3078       | -2.40%                 |
| 96   | 50  | 0.1      | 20.26                | 3617.77 | 0.12       | 19.87                | 3.26   | 366        | 3458       | -1.93%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 97   | 50  | 0.1      | 18.27                | 3629.96 | 0.39       | 17.79                | 2.88   | 273        | 2901       | -2.65%                 |
| 98   | 50  | 0.1      | 19.68                | 3621.90 | 0.15       | 17.77                | 2.98   | 338        | 2938       | -9.70%                 |
| 99   | 50  | 0.1      | 18.36                | 3616.26 | 0.32       | 18.24                | 3.23   | 300        | 3159       | -0.67%                 |
| 100  | 50  | 0.1      | 18.50                | 3609.72 | 0.39       | 18.45                | 3.54   | 353        | 3153       | -0.28%                 |
| 101  | 50  | 0.5      | 86.74                | 3605.90 | 0.16       | 43.23                | 42.85  | 1669       | 14604      | -50.17%                |
| 102  | 50  | 0.5      | 47.64                | 3621.85 | 0.11       | 46.81                | 48.62  | 1734       | 15285      | -1.73%                 |
| 103  | 50  | 0.5      | 45.88                | 3620.20 | 0.79       | 44.65                | 50.93  | 1658       | 15391      | -2.69%                 |
| 104  | 50  | 0.5      | 46.64                | 3627.14 | 0.19       | 45.52                | 51.05  | 1685       | 14733      | -2.39%                 |
| 105  | 50  | 0.5      | 43.32                | 3669.47 | 0.08       | 42.53                | 43.14  | 1554       | 14308      | -1.84%                 |
| 106  | 50  | 0.5      | 45.20                | 3642.91 | 0.23       | 43.38                | 49.40  | 1659       | 14426      | -4.02%                 |
| 107  | 50  | 0.5      | 45.70                | 3668.60 | 0.14       | 44.98                | 46.40  | 1571       | 15283      | -1.57%                 |
| 108  | 50  | 0.5      | 90.17                | 4052.75 | 0.30       | 44.63                | 49.04  | 1613       | 15192      | -50.51%                |
| 109  | 50  | 0.5      | 44.40                | 3645.66 | 0.32       | 44.13                | 48.50  | 1593       | 14548      | -0.60%                 |
| 110  | 50  | 0.5      | 47.42                | 3650.40 | 0.23       | 45.99                | 50.39  | 1562       | 15334      | -3.01%                 |
| 111  | 50  | 0.5      | 84.82                | 3623.50 | 0.19       | 43.27                | 40.26  | 1552       | 14281      | -48.98%                |
| 112  | 50  | 0.5      | 85.78                | 3619.58 | 0.19       | 43.43                | 39.09  | 1494       | 14417      | -49.37%                |
| 113  | 50  | 0.5      | 45.01                | 3644.29 | 0.20       | 44.62                | 51.34  | 1682       | 15301      | -0.87%                 |
| 114  | 50  | 0.5      | 45.57                | 3643.95 | 0.10       | 44.30                | 45.08  | 1469       | 14465      | -2.78%                 |
| 115  | 50  | 0.5      | 45.56                | 3643.58 | 0.81       | 45.46                | 49.48  | 1617       | 15460      | -0.23%                 |
| 116  | 50  | 0.5      | 45.79                | 3648.49 | 0.28       | 45.45                | 42.72  | 1577       | 14911      | -0.75%                 |
| 117  | 50  | 0.5      | 47.67                | 3647.74 | 0.31       | 45.94                | 55.58  | 1726       | 15442      | -3.62%                 |
| 118  | 50  | 0.5      | 88.20                | 4029.41 | 0.07       | 44.83                | 31.14  | 1646       | 15151      | -49.17%                |
| 119  | 50  | 0.5      | 91.36                | 3624.77 | 0.14       | 43.88                | 44.80  | 1680       | 14991      | -51.97%                |
| 120  | 50  | 0.5      | 42.78                | 3644.03 | 0.49       | 42.74                | 33.05  | 1499       | 14315      | -0.09%                 |
| 121  | 50  | 0.5      | 47.21                | 3627.63 | 0.18       | 46.11                | 50.81  | 1692       | 15526      | -2.33%                 |
| 122  | 50  | 0.5      | 44.76                | 3646.86 | 0.24       | 43.43                | 48.50  | 1662       | 14858      | -2.97%                 |
| 123  | 50  | 0.5      | 46.88                | 3638.27 | 0.25       | 46.27                | 48.93  | 1747       | 15616      | -1.31%                 |
| 124  | 50  | 0.5      | 44.99                | 3626.09 | 0.23       | 44.14                | 41.50  | 1600       | 14673      | -1.88%                 |
| 125  | 50  | 0.5      | 45.32                | 3619.02 | 0.33       | 43.25                | 45.06  | 1583       | 14459      | -4.57%                 |
| 126  | 50  | 2.0      | 87.01                | 3660.80 | 0.29       | 86.74                | 467.25 | 5297       | 48444      | -0.31%                 |
| 127  | 50  | 2.0      | 91.65                | 3742.81 | 0.08       | 91.03                | 529.30 | 5427       | 50727      | -0.67%                 |
| 128  | 50  | 2.0      | 87.17                | 3720.23 | 0.59       | 86.87                | 509.46 | 5365       | 48351      | -0.35%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 129  | 50  | 2.0      | 91.65                | 3806.36 | 0.26       | 90.24                | 594.20 | 5696       | 50038      | -1.54%                 |
| 130  | 50  | 2.0      | 83.80                | 4124.58 | 0.12       | 83.27                | 511.49 | 5084       | 46301      | -0.63%                 |
| 131  | 50  | 2.0      | 86.06                | 3846.18 | 0.16       | 84.55                | 520.72 | 5485       | 47993      | -1.76%                 |
| 132  | 50  | 2.0      | 88.91                | 3797.90 | 0.24       | 87.98                | 513.15 | 5471       | 49469      | -1.05%                 |
| 133  | 50  | 2.0      | 90.59                | 3650.09 | 0.19       | 90.17                | 524.14 | 5580       | 50026      | -0.46%                 |
| 134  | 50  | 2.0      | 85.03                | 4005.65 | 0.45       | 83.23                | 445.01 | 5138       | 45303      | -2.11%                 |
| 135  | 50  | 2.0      | 95.12                | 4096.08 | 0.06       | 94.21                | 537.40 | 5846       | 52312      | -0.96%                 |
| 136  | 50  | 2.0      | 85.27                | 3645.09 | 0.39       | 84.82                | 442.56 | 5183       | 46294      | -0.53%                 |
| 137  | 50  | 2.0      | 84.52                | 3648.72 | 0.22       | 83.79                | 503.76 | 5558       | 47304      | -0.86%                 |
| 138  | 50  | 2.0      | 91.58                | 4044.07 | 0.20       | 89.42                | 630.55 | 5716       | 50405      | -2.36%                 |
| 139  | 50  | 2.0      | 87.06                | 3948.95 | 0.03       | 86.39                | 474.36 | 5454       | 48125      | -0.77%                 |
| 140  | 50  | 2.0      | 90.40                | 4036.42 | 0.91       | 89.53                | 384.71 | 5358       | 49856      | -0.96%                 |
| 141  | 50  | 2.0      | 89.46                | 4012.63 | 0.31       | 87.53                | 471.20 | 6497       | 51278      | -2.16%                 |
| 142  | 50  | 2.0      | 89.92                | 4056.53 | 0.01       | 89.14                | 489.28 | 5439       | 49613      | -0.87%                 |
| 143  | 50  | 2.0      | 88.56                | 3652.33 | 0.15       | 87.89                | 462.27 | 5050       | 48560      | -0.76%                 |
| 144  | 50  | 2.0      | 92.10                | 3645.63 | 0.14       | 91.13                | 578.47 | 5806       | 51126      | -1.05%                 |
| 145  | 50  | 2.0      | 83.56                | 3980.05 | 0.51       | 83.24                | 430.14 | 5078       | 46211      | -0.38%                 |
| 146  | 50  | 2.0      | 92.39                | 3784.06 | 0.28       | 92.02                | 576.61 | 5781       | 52166      | -0.40%                 |
| 147  | 50  | 2.0      | 88.73                | 3818.03 | 0.40       | 87.20                | 556.91 | 5575       | 48379      | -1.73%                 |
| 148  | 50  | 2.0      | 94.38                | 3947.41 | 0.22       | 93.87                | 624.30 | 5734       | 52547      | -0.54%                 |
| 149  | 50  | 2.0      | 88.13                | 3772.46 | 0.32       | 88.05                | 514.46 | 5370       | 48483      | -0.10%                 |
| 150  | 50  | 2.0      | 85.12                | 3707.72 | 0.46       | 85.07                | 538.39 | 5207       | 47582      | -0.07%                 |
| 151  | 75  | 0.1      | 17.45                | 3606.90 | 0.20       | 17.04                | 4.25   | 294        | 2794       | -2.35%                 |
| 152  | 75  | 0.1      | 45.69                | 4018.50 | 0.18       | 17.41                | 5.56   | 335        | 3049       | -61.90%                |
| 153  | 75  | 0.1      | 19.72                | 3606.20 | 0.19       | 18.74                | 6.36   | 380        | 3088       | -4.99%                 |
| 154  | 75  | 0.1      | 19.56                | 3615.41 | 0.19       | 18.35                | 5.46   | 397        | 3116       | -6.20%                 |
| 155  | 75  | 0.1      | 44.14                | 3712.40 | 0.08       | 17.67                | 4.91   | 374        | 2985       | -59.96%                |
| 156  | 75  | 0.1      | 18.37                | 3615.45 | 0.47       | 17.60                | 4.52   | 331        | 3011       | -4.22%                 |
| 157  | 75  | 0.1      | 45.66                | 3732.92 | 0.23       | 17.57                | 4.47   | 306        | 2998       | -61.52%                |
| 158  | 75  | 0.1      | 17.44                | 3615.57 | 0.14       | 17.35                | 4.22   | 294        | 2877       | -0.53%                 |
| 159  | 75  | 0.1      | 17.88                | 3616.11 | 0.23       | 17.85                | 5.68   | 311        | 2960       | -0.18%                 |
| 160  | 75  | 0.1      | 19.33                | 3613.54 | 0.18       | 18.49                | 5.30   | 353        | 3132       | -4.34%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |       |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|-------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)  | # $\rho_S$ | # $\rho_L$ |                        |
| 161  | 75  | 0.1      | 19.23                | 3616.25 | 0.07       | 18.71                | 4.81  | 375        | 3158       | -2.73%                 |
| 162  | 75  | 0.1      | 17.99                | 3610.60 | 0.08       | 17.74                | 4.76  | 355        | 2976       | -1.41%                 |
| 163  | 75  | 0.1      | 17.61                | 3605.80 | 0.47       | 17.41                | 4.17  | 336        | 2884       | -1.16%                 |
| 164  | 75  | 0.1      | 44.57                | 3978.80 | 0.25       | 18.26                | 5.15  | 323        | 3047       | -59.03%                |
| 165  | 75  | 0.1      | 43.72                | 3723.88 | 0.20       | 18.58                | 4.82  | 341        | 3154       | -57.49%                |
| 166  | 75  | 0.1      | 19.11                | 3615.68 | 0.13       | 18.24                | 4.64  | 311        | 3139       | -4.58%                 |
| 167  | 75  | 0.1      | 18.95                | 3614.89 | 0.25       | 18.62                | 5.42  | 373        | 3201       | -1.73%                 |
| 168  | 75  | 0.1      | 17.76                | 3615.71 | 0.17       | 17.48                | 4.23  | 271        | 2819       | -1.58%                 |
| 169  | 75  | 0.1      | 45.85                | 3754.21 | 0.22       | 18.10                | 5.00  | 406        | 3297       | -60.51%                |
| 170  | 75  | 0.1      | 18.61                | 3615.36 | 0.17       | 18.13                | 4.45  | 334        | 3152       | -2.58%                 |
| 171  | 75  | 0.1      | 45.02                | 3738.69 | 0.27       | 18.05                | 4.51  | 307        | 3110       | -59.89%                |
| 172  | 75  | 0.1      | 18.47                | 3615.15 | 0.23       | 18.28                | 4.41  | 334        | 3048       | -1.00%                 |
| 173  | 75  | 0.1      | 19.01                | 3614.02 | 0.09       | 17.19                | 4.48  | 354        | 2923       | -9.57%                 |
| 174  | 75  | 0.1      | 17.64                | 3616.30 | 0.13       | 16.16                | 4.59  | 316        | 2704       | -8.38%                 |
| 175  | 75  | 0.1      | 19.72                | 3623.43 | 0.11       | 18.91                | 5.14  | 371        | 3167       | -4.12%                 |
| 176  | 75  | 0.5      | 44.83                | 3665.10 | 0.19       | 44.75                | 54.99 | 1627       | 14736      | -0.18%                 |
| 177  | 75  | 0.5      | 92.00                | 3605.70 | 0.17       | 45.69                | 62.44 | 1577       | 15288      | -50.34%                |
| 178  | 75  | 0.5      | 46.82                | 3670.30 | 0.19       | 46.37                | 68.38 | 1776       | 15481      | -0.95%                 |
| 179  | 75  | 0.5      | 44.93                | 3625.83 | 0.18       | 44.58                | 61.73 | 1656       | 14746      | -0.79%                 |
| 180  | 75  | 0.5      | 44.80                | 3607.30 | 0.18       | 44.09                | 57.76 | 1666       | 14869      | -1.58%                 |
| 181  | 75  | 0.5      | 46.41                | 3626.65 | 0.34       | 45.21                | 61.31 | 1567       | 15200      | -2.58%                 |
| 182  | 75  | 0.5      | 89.22                | 3614.02 | 0.22       | 45.65                | 58.86 | 1652       | 15037      | -48.84%                |
| 183  | 75  | 0.5      | 44.47                | 3626.84 | 0.18       | 43.54                | 57.13 | 1615       | 14205      | -2.09%                 |
| 184  | 75  | 0.5      | 44.67                | 3626.06 | 0.18       | 44.58                | 54.03 | 1634       | 15094      | -0.21%                 |
| 185  | 75  | 0.5      | 46.08                | 3624.66 | 0.03       | 44.32                | 48.95 | 1679       | 14916      | -3.82%                 |
| 186  | 75  | 0.5      | 46.81                | 3626.13 | 0.12       | 45.64                | 58.39 | 1635       | 15487      | -2.49%                 |
| 187  | 75  | 0.5      | 45.90                | 3631.30 | 0.09       | 45.22                | 44.34 | 1716       | 14954      | -1.49%                 |
| 188  | 75  | 0.5      | 43.65                | 3620.10 | 0.26       | 43.31                | 53.88 | 1552       | 14755      | -0.77%                 |
| 189  | 75  | 0.5      | 88.24                | 3609.70 | 0.23       | 44.57                | 63.34 | 1683       | 14772      | -49.49%                |
| 190  | 75  | 0.5      | 87.26                | 3615.09 | 0.20       | 43.72                | 46.02 | 1691       | 14710      | -49.90%                |
| 191  | 75  | 0.5      | 45.75                | 3625.98 | 0.16       | 45.14                | 51.72 | 1606       | 15116      | -1.33%                 |
| 192  | 75  | 0.5      | 89.09                | 3729.23 | 0.17       | 45.86                | 52.47 | 1615       | 15348      | -48.52%                |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 193  | 75  | 0.5      | 44.46                | 3625.73 | 0.16       | 44.32                | 53.39  | 1643       | 14640      | -0.32%                 |
| 194  | 75  | 0.5      | 89.36                | 3616.54 | 0.23       | 45.85                | 66.99  | 1812       | 15773      | -48.70%                |
| 195  | 75  | 0.5      | 45.49                | 3626.31 | 0.14       | 45.29                | 57.18  | 1605       | 15048      | -0.44%                 |
| 196  | 75  | 0.5      | 88.76                | 3615.08 | 0.88       | 45.02                | 46.54  | 1526       | 14854      | -49.28%                |
| 197  | 75  | 0.5      | 44.53                | 3624.52 | 0.15       | 44.29                | 40.32  | 1643       | 14621      | -0.52%                 |
| 198  | 75  | 0.5      | 46.75                | 3624.74 | 0.08       | 45.83                | 53.43  | 1758       | 15295      | -1.97%                 |
| 199  | 75  | 0.5      | 84.86                | 3721.12 | 0.07       | 43.45                | 47.45  | 1520       | 14662      | -48.80%                |
| 200  | 75  | 0.5      | 47.34                | 3633.66 | 0.10       | 46.90                | 64.89  | 1717       | 15806      | -0.92%                 |
| 201  | 75  | 2.0      | 87.45                | 3809.00 | 0.35       | 86.82                | 493.50 | 5275       | 47741      | -0.72%                 |
| 202  | 75  | 2.0      | 92.65                | 3645.50 | 0.17       | 91.84                | 641.25 | 5427       | 52552      | -0.88%                 |
| 203  | 75  | 2.0      | 90.81                | 4060.70 | 0.16       | 90.20                | 684.60 | 5702       | 50871      | -0.67%                 |
| 204  | 75  | 2.0      | 87.51                | 3728.00 | 0.19       | 86.91                | 537.13 | 5315       | 47441      | -0.68%                 |
| 205  | 75  | 2.0      | 87.92                | 4086.60 | 0.13       | 87.44                | 583.15 | 5642       | 49670      | -0.54%                 |
| 206  | 75  | 2.0      | 88.70                | 3728.05 | 0.19       | 88.19                | 563.32 | 5686       | 49278      | -0.57%                 |
| 207  | 75  | 2.0      | 88.70                | 3626.84 | 0.20       | 87.97                | 539.24 | 5293       | 50037      | -0.83%                 |
| 208  | 75  | 2.0      | 86.34                | 3748.83 | 0.14       | 84.95                | 593.23 | 5228       | 47321      | -1.61%                 |
| 209  | 75  | 2.0      | 86.80                | 3737.31 | 0.32       | 85.22                | 600.64 | 5107       | 48074      | -1.82%                 |
| 210  | 75  | 2.0      | 88.66                | 3731.27 | 0.18       | 87.59                | 636.23 | 5337       | 49343      | -1.21%                 |
| 211  | 75  | 2.0      | 91.79                | 3742.84 | 0.09       | 91.17                | 690.30 | 5732       | 52049      | -0.67%                 |
| 212  | 75  | 2.0      | 90.28                | 4104.80 | 0.27       | 89.15                | 745.33 | 6322       | 50721      | -1.26%                 |
| 213  | 75  | 2.0      | 86.92                | 4364.50 | 0.25       | 85.50                | 568.64 | 5113       | 48856      | -1.63%                 |
| 214  | 75  | 2.0      | 86.89                | 3742.80 | 0.07       | 86.13                | 557.31 | 5721       | 49494      | -0.88%                 |
| 215  | 75  | 2.0      | 87.42                | 3624.47 | 0.15       | 87.26                | 602.41 | 5501       | 49551      | -0.18%                 |
| 216  | 75  | 2.0      | 88.08                | 3735.99 | 0.18       | 87.96                | 564.57 | 5321       | 48373      | -0.14%                 |
| 217  | 75  | 2.0      | 89.27                | 3625.88 | 0.34       | 88.39                | 664.75 | 5652       | 48873      | -0.98%                 |
| 218  | 75  | 2.0      | 88.59                | 3737.52 | 0.33       | 86.43                | 607.93 | 5350       | 48388      | -2.43%                 |
| 219  | 75  | 2.0      | 89.95                | 3629.29 | 0.13       | 89.36                | 267.64 | 5639       | 50191      | -0.65%                 |
| 220  | 75  | 2.0      | 91.06                | 3743.85 | 0.16       | 89.23                | 637.18 | 5433       | 49317      | -2.01%                 |
| 221  | 75  | 2.0      | 86.96                | 3625.73 | 0.16       | 86.04                | 552.72 | 5360       | 49796      | -1.05%                 |
| 222  | 75  | 2.0      | 87.73                | 3732.00 | 0.24       | 86.35                | 586.00 | 5441       | 48935      | -1.57%                 |
| 223  | 75  | 2.0      | 91.55                | 3740.45 | 0.10       | 90.16                | 594.08 | 5788       | 50870      | -1.52%                 |
| 224  | 75  | 2.0      | 83.79                | 3626.57 | 0.17       | 82.98                | 558.92 | 5171       | 47061      | -0.97%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |         | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|---------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)    | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 225  | 75  | 2.0      | 93.15                | 3783.96 | 0.21       | 92.25                | 777.65 | 5700       | 51659      | -0.97%                 |
| 226  | 100 | 0.1      | 90.65                | 3622.20 | 0.10       | 18.48                | 6.32   | 350        | 3127       | -79.62%                |
| 227  | 100 | 0.1      | 18.69                | 3693.47 | 0.10       | 17.20                | 5.67   | 323        | 2900       | -7.96%                 |
| 228  | 100 | 0.1      | 44.94                | 4177.40 | 0.11       | 18.19                | 5.18   | 339        | 3050       | -59.52%                |
| 229  | 100 | 0.1      | 19.35                | 3692.54 | 0.15       | 17.23                | 5.26   | 333        | 2878       | -10.95%                |
| 230  | 100 | 0.1      | 18.88                | 3701.43 | 0.12       | 16.87                | 5.69   | 331        | 2963       | -10.64%                |
| 231  | 100 | 0.1      | 18.82                | 3689.92 | 0.04       | 17.97                | 5.34   | 322        | 2941       | -4.53%                 |
| 232  | 100 | 0.1      | 18.32                | 3693.98 | 0.76       | 17.69                | 5.86   | 345        | 3025       | -3.41%                 |
| 233  | 100 | 0.1      | 44.33                | 4284.02 | 0.54       | 17.31                | 5.84   | 357        | 3021       | -60.96%                |
| 234  | 100 | 0.1      | 45.60                | 4308.74 | 0.12       | 18.43                | 5.30   | 336        | 3010       | -59.58%                |
| 235  | 100 | 0.1      | 44.88                | 3736.23 | 0.31       | 18.11                | 5.49   | 388        | 3234       | -59.65%                |
| 236  | 100 | 0.1      | 19.05                | 3605.10 | 0.15       | 17.84                | 5.14   | 319        | 3001       | -6.38%                 |
| 237  | 100 | 0.1      | 86.94                | 3740.43 | 0.09       | 17.34                | 5.83   | 291        | 2869       | -80.05%                |
| 238  | 100 | 0.1      | 90.94                | 3674.20 | 0.18       | 19.29                | 6.13   | 391        | 3295       | -78.79%                |
| 239  | 100 | 0.1      | 18.93                | 3685.80 | 0.09       | 18.35                | 5.44   | 375        | 3182       | -3.06%                 |
| 240  | 100 | 0.1      | 88.22                | 3676.80 | 0.10       | 17.96                | 5.15   | 295        | 2971       | -79.64%                |
| 241  | 100 | 0.1      | 46.09                | 4425.62 | 0.06       | 17.93                | 5.12   | 311        | 3056       | -61.10%                |
| 242  | 100 | 0.1      | 45.50                | 4317.80 | 0.16       | 18.60                | 5.67   | 362        | 3168       | -59.12%                |
| 243  | 100 | 0.1      | 19.10                | 3691.62 | 0.16       | 18.12                | 5.12   | 259        | 2880       | -5.08%                 |
| 244  | 100 | 0.1      | 18.47                | 3608.00 | 0.13       | 18.00                | 5.55   | 354        | 3068       | -2.57%                 |
| 245  | 100 | 0.1      | 20.51                | 3694.13 | 0.05       | 17.59                | 5.10   | 257        | 3022       | -14.22%                |
| 246  | 100 | 0.1      | 18.60                | 3611.20 | 0.05       | 18.04                | 4.93   | 332        | 2937       | -3.01%                 |
| 247  | 100 | 0.1      | 18.34                | 3615.60 | 0.09       | 17.09                | 5.39   | 332        | 2944       | -6.82%                 |
| 248  | 100 | 0.1      | 19.88                | 3608.94 | 0.62       | 17.83                | 5.77   | 303        | 3041       | -10.31%                |
| 249  | 100 | 0.1      | 17.88                | 3611.90 | 0.70       | 16.83                | 4.88   | 340        | 2923       | -5.91%                 |
| 250  | 100 | 0.1      | 19.12                | 3615.60 | 0.16       | 17.93                | 5.56   | 333        | 3087       | -6.20%                 |
| 251  | 100 | 0.5      | 47.23                | 4379.00 | 0.09       | 46.39                | 58.58  | 1765       | 15681      | -1.78%                 |
| 252  | 100 | 0.5      | 45.52                | 3736.54 | 0.07       | 44.50                | 59.18  | 1763       | 14886      | -2.25%                 |
| 253  | 100 | 0.5      | 88.27                | 3611.10 | 0.15       | 44.94                | 53.09  | 1608       | 14893      | -49.09%                |
| 254  | 100 | 0.5      | 44.83                | 3729.63 | 0.08       | 44.56                | 52.29  | 1735       | 15014      | -0.59%                 |
| 255  | 100 | 0.5      | 44.85                | 3744.79 | 0.08       | 44.71                | 55.18  | 1670       | 14804      | -0.30%                 |
| 256  | 100 | 0.5      | 45.28                | 3729.32 | 0.08       | 45.21                | 54.01  | 1623       | 14869      | -0.16%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |          | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|----------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)     | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 257  | 100 | 0.5      | 46.39                | 3732.47  | 0.66       | 45.47                | 60.09  | 1758       | 15342      | -1.98%                 |
| 258  | 100 | 0.5      | 86.08                | 3691.56  | 0.60       | 44.33                | 58.59  | 1720       | 15018      | -48.51%                |
| 259  | 100 | 0.5      | 88.88                | 3689.87  | 0.23       | 45.60                | 61.45  | 1772       | 15068      | -48.70%                |
| 260  | 100 | 0.5      | 45.01                | 3688.63  | 0.23       | 44.37                | 58.52  | 1733       | 14892      | -1.43%                 |
| 261  | 100 | 0.5      | 47.58                | 3722.30  | 0.17       | 47.43                | 78.49  | 1874       | 16123      | -0.30%                 |
| 262  | 100 | 0.5      | 44.80                | 4303.91  | 0.77       | 44.23                | 56.92  | 1570       | 14549      | -1.29%                 |
| 263  | 100 | 0.5      | 46.50                | 4234.90  | 0.15       | 46.13                | 65.98  | 1658       | 15541      | -0.80%                 |
| 264  | 100 | 0.5      | 45.97                | 3736.39  | 0.11       | 45.52                | 58.72  | 1778       | 15356      | -0.98%                 |
| 265  | 100 | 0.5      | 44.55                | 3868.80  | 0.04       | 44.54                | 52.73  | 1635       | 14971      | -0.03%                 |
| 266  | 100 | 0.5      | 91.96                | 3693.67  | 0.09       | 46.09                | 68.99  | 1757       | 15372      | -49.88%                |
| 267  | 100 | 0.5      | 87.60                | 3611.00  | 0.10       | 45.38                | 65.52  | 1639       | 15211      | -48.19%                |
| 268  | 100 | 0.5      | 46.56                | 3738.43  | 0.11       | 46.25                | 57.99  | 1765       | 15484      | -0.68%                 |
| 269  | 100 | 0.5      | 46.05                | 3725.90  | 0.28       | 45.40                | 60.09  | 1635       | 15331      | -1.43%                 |
| 270  | 100 | 0.5      | 46.69                | 3742.27  | 0.15       | 46.47                | 67.73  | 1618       | 15520      | -0.46%                 |
| 271  | 100 | 0.5      | 46.32                | 3646.30  | 0.12       | 46.05                | 61.03  | 1660       | 15143      | -0.58%                 |
| 272  | 100 | 0.5      | 86.65                | 11024.40 | 0.11       | 44.71                | 53.53  | 1735       | 15087      | -48.40%                |
| 273  | 100 | 0.5      | 47.34                | 3637.80  | 0.54       | 46.35                | 64.97  | 1684       | 15502      | -2.10%                 |
| 274  | 100 | 0.5      | 44.80                | 3653.90  | 0.34       | 44.72                | 61.16  | 1573       | 14788      | -0.20%                 |
| 275  | 100 | 0.5      | 45.38                | 3660.50  | 0.06       | 45.10                | 57.20  | 1679       | 15074      | -0.62%                 |
| 276  | 100 | 2.0      | 90.73                | 3604.00  | 0.06       | 90.65                | 615.36 | 5613       | 50446      | -0.09%                 |
| 277  | 100 | 2.0      | 87.83                | 4350.05  | 0.18       | 86.81                | 582.74 | 5302       | 48753      | -1.17%                 |
| 278  | 100 | 2.0      | 86.85                | 3742.40  | 0.16       | 85.99                | 551.26 | 5563       | 48764      | -0.99%                 |
| 279  | 100 | 2.0      | 87.62                | 4314.04  | 0.25       | 87.60                | 569.99 | 5507       | 49812      | -0.02%                 |
| 280  | 100 | 2.0      | 85.71                | 4289.95  | 0.00       | 84.66                | 508.94 | 5391       | 48027      | -1.23%                 |
| 281  | 100 | 2.0      | 87.40                | 4312.90  | 0.21       | 86.99                | 622.38 | 5357       | 48299      | -0.46%                 |
| 282  | 100 | 2.0      | 88.23                | 4339.81  | 0.60       | 88.10                | 625.62 | 5433       | 49473      | -0.15%                 |
| 283  | 100 | 2.0      | 86.37                | 3736.75  | 0.71       | 86.08                | 606.90 | 5612       | 48571      | -0.33%                 |
| 284  | 100 | 2.0      | 88.60                | 3737.38  | 0.17       | 87.78                | 593.95 | 5317       | 49467      | -0.92%                 |
| 285  | 100 | 2.0      | 86.99                | 4302.11  | 0.24       | 85.63                | 501.07 | 5438       | 47315      | -1.56%                 |
| 286  | 100 | 2.0      | 94.17                | 3803.20  | 0.17       | 93.96                | 766.93 | 6009       | 53910      | -0.23%                 |
| 287  | 100 | 2.0      | 87.72                | 3689.67  | 0.70       | 86.85                | 596.05 | 5192       | 48768      | -1.00%                 |
| 288  | 100 | 2.0      | 88.85                | 3609.40  | 0.12       | 87.97                | 656.32 | 5496       | 51275      | -0.98%                 |

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Table 3: Result of SimExact X SimSA-CVaR (Continued)

| Inst | $n$ | $\delta$ | SimExact             |          | SimSA-CVaR |                      |        |            |            | GAP <sub>a,b</sub> (%) |
|------|-----|----------|----------------------|----------|------------|----------------------|--------|------------|------------|------------------------|
|      |     |          | C-RPD <sup>(a)</sup> | T(s)     | D-RPD      | C-RPD <sup>(b)</sup> | T(s)   | # $\rho_S$ | # $\rho_L$ |                        |
| 289  | 100 | 2.0      | 86.22                | 4323.21  | 0.03       | 86.17                | 637.78 | 5330       | 50215      | -0.06%                 |
| 290  | 100 | 2.0      | 87.37                | 3609.30  | 0.16       | 86.67                | 550.98 | 5675       | 49571      | -0.80%                 |
| 291  | 100 | 2.0      | 90.88                | 3738.96  | 0.06       | 89.91                | 663.24 | 5725       | 51255      | -1.07%                 |
| 292  | 100 | 2.0      | 88.41                | 3668.60  | 0.09       | 87.51                | 550.66 | 5392       | 48894      | -1.02%                 |
| 293  | 100 | 2.0      | 88.36                | 4351.22  | 0.01       | 88.14                | 637.28 | 5710       | 49713      | -0.25%                 |
| 294  | 100 | 2.0      | 89.09                | 3835.40  | 0.23       | 88.81                | 549.72 | 5808       | 49672      | -0.30%                 |
| 295  | 100 | 2.0      | 89.51                | 4349.52  | 0.15       | 89.03                | 623.46 | 5672       | 50799      | -0.53%                 |
| 296  | 100 | 2.0      | 90.64                | 4244.40  | 0.13       | 88.68                | 609.56 | 5563       | 50656      | -2.17%                 |
| 297  | 100 | 2.0      | 85.81                | 3632.40  | 0.28       | 85.04                | 485.82 | 5460       | 48133      | -0.91%                 |
| 298  | 100 | 2.0      | 91.67                | 4134.42  | 0.72       | 89.29                | 573.78 | 5923       | 51503      | -2.59%                 |
| 299  | 100 | 2.0      | 86.44                | 11021.80 | 0.30       | 85.24                | 507.14 | 5303       | 48295      | -1.39%                 |
| 300  | 100 | 2.0      | 85.14                | 4045.80  | 0.66       | 84.85                | 580.48 | 5430       | 47682      | -0.34%                 |