

SIMHEURISTIC APPROACH TO THE SINGLE-MACHINE SCHEDULING PROBLEM WITH STOCHASTIC PROCESSING TIMES AND ENERGY-EFFICIENT

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Abstract

This article addresses the stochastic version of the single-machine scheduling problem with environmental considerations. In this context, jobs processing times behave as random variables, and the total energy consumption depends on which jobs are processed in which periods, since each job has its own energy consumption and each period has its energy tariff due to the Time-Of-Use policy. The objective of this paper is to propose a simheuristic algorithm to minimize total energy consumption under different uncertainty scenarios. The proposed algorithm, called **SimSA**, combines the metaheuristics Simulated Annealing and Greedy Randomized Adaptive Search Procedure to perform the search in the solution space, along with Monte Carlo Simulation to generate random values. The **SimSA** results were compared with the simulation of the best solution using deterministic parameters, and **SimSA** achieved better results in the stochastic metrics Average, Value at Risk (*VaR*), and Conditional Value at Risk (*CVaR*). These results highlight the importance of incorporating uncertainties present in processes and emphasize the relevance of the proposed simheuristic.

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Keywords: Green Scheduling, Time-Of-use (TOU), Stochastic Processing Time.

1. SimSA-Expected X SimExact

Table 1: Result of SimExact x SimSA-Expected

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
1	0.1	3.83	200.30	0.56	2.31	8.93	354	3319	-39.74%
1	0.5	7.28	342.30	0.44	6.00	19.31	1527	14265	-17.54%
1	2.0	13.07	915.20	0.44	12.35	303.83	5326	47260	-5.52%
2	0.1	6.48	187.00	0.63	2.48	2.36	308	3297	-61.80%
2	0.5	10.78	214.00	0.76	6.76	53.66	1738	15239	-37.35%
2	2.0	16.51	791.40	0.76	14.16	588.97	5890	52549	-14.23%
3	0.1	4.02	134.10	0.67	3.98	3.53	426	3847	-0.89%
3	0.5	8.85	240.50	0.31	8.42	44.55	1756	16186	-4.94%
3	2.0	14.75	441.10	0.87	14.01	597.31	5749	50486	-4.98%
4	0.1	3.86	374.80	0.83	3.19	2.86	437	3773	-17.35%
4	0.5	8.44	458.20	0.75	6.90	42.91	1729	14762	-18.16%
4	2.0	14.73	828.80	0.91	12.93	486.02	5303	48564	-12.22%
5	0.1	2.35	265.40	0.29	2.13	2.11	352	3090	-9.48%
5	0.5	6.61	276.10	0.30	6.44	35.27	1672	14129	-2.53%
5	2.0	12.96	850.70	0.29	12.28	406.07	5402	47615	-5.30%
6	0.1	3.97	228.40	0.27	3.01	2.23	381	3276	-24.32%
6	0.5	8.26	297.40	0.39	8.11	41.09	1762	15963	-1.78%
6	2.0	14.39	974.90	1.05	13.90	558.28	5418	51102	-3.45%
7	0.1	6.61	3604.91	0.12	1.89	2.04	364	3148	-71.38%
7	0.5	9.56	3617.21	0.19	5.92	34.53	1580	14319	-38.15%
7	2.0	14.45	3770.04	0.31	11.37	360.71	4917	44620	-21.36%
8	0.1	3.81	381.00	0.56	2.34	2.15	386	3246	-38.62%
8	0.5	8.29	460.90	0.72	6.31	41.01	1605	15884	-23.93%
8	2.0	13.93	1099.90	0.90	12.84	488.31	5612	50543	-7.78%
9	0.1	3.83	346.40	0.50	2.42	2.42	349	3148	-36.83%
9	0.5	8.10	432.30	0.15	6.64	35.80	1661	14819	-17.96%
9	2.0	13.30	777.40	0.26	12.36	429.53	5405	48186	-7.06%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
10	0.1	4.42	265.20	0.83	3.96	3.67	415	3405	-10.30%
10	0.5	9.30	400.40	0.90	9.10	48.97	1719	15262	-2.18%
10	2.0	14.92	751.20	0.86	14.23	539.26	5397	47578	-4.59%
11	0.1	8.75	366.60	0.26	2.28	2.92	361	3367	-73.93%
11	0.5	11.46	450.80	0.33	6.32	46.05	1744	14993	-44.85%
11	2.0	15.48	630.90	0.35	12.28	488.30	5202	48575	-20.65%
12	0.1	8.24	168.70	0.44	1.80	3.07	349	3074	-78.12%
12	0.5	11.47	266.10	0.42	6.61	32.68	1700	14827	-42.37%
12	2.0	15.50	904.60	0.60	12.80	521.06	5446	49819	-17.41%
13	0.1	3.95	285.30	0.01	2.30	1.44	348	2778	-41.68%
13	0.5	8.47	291.30	1.25	7.29	44.55	1635	15311	-13.88%
13	2.0	14.26	584.70	1.52	13.37	946.72	5839	50658	-6.22%
14	0.1	2.99	342.60	0.60	2.53	8.03	394	3652	-15.23%
14	0.5	9.45	432.00	1.22	8.45	204.10	2130	19637	-10.54%
14	2.0	20.16	616.70	1.22	18.16	3898.11	8269	72209	-9.92%
15	0.1	2.75	257.20	0.15	2.41	2.05	345	2904	-12.06%
15	0.5	6.84	325.90	0.01	6.68	30.17	1576	14480	-2.35%
15	2.0	14.48	640.90	1.45	13.39	578.84	5835	51753	-7.51%
16	0.1	3.68	391.40	0.39	2.94	2.79	365	3275	-20.11%
16	0.5	8.72	467.20	0.32	7.95	50.21	1675	16068	-8.76%
16	2.0	16.85	607.20	0.32	16.16	611.14	6366	56216	-4.09%
17	0.1	8.36	243.80	0.37	2.61	1.99	311	3017	-68.76%
17	0.5	11.80	309.70	0.49	7.20	36.49	1572	14691	-38.93%
17	2.0	16.38	710.20	0.82	13.10	425.87	5430	48372	-20.00%
18	0.1	2.99	218.00	0.35	2.35	2.76	350	3391	-21.44%
18	0.5	7.43	252.40	0.33	7.34	36.27	1709	15654	-1.16%
18	2.0	14.46	813.00	0.30	14.11	523.76	5512	50979	-2.38%
19	0.1	14.16	638.00	0.24	14.02	2.13	337	3165	-0.95%
19	0.5	2.78	243.20	0.22	2.69	37.64	1640	15466	-3.25%
19	2.0	7.54	359.20	0.24	7.41	458.64	5398	50068	-1.65%
20	0.1	2.70	368.10	0.43	2.23	1.92	333	2995	-17.34%
20	0.5	6.16	380.20	0.21	5.98	34.94	1562	14131	-2.97%
20	2.0	12.16	879.60	0.29	11.51	358.55	4871	45564	-5.39%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
21	0.1	2.67	3607.43	0.45	2.39	2.12	310	2904	-10.56%
21	0.5	7.02	3626.84	0.02	6.91	28.14	1559	13709	-1.55%
21	2.0	12.68	3844.08	1.82	12.07	447.32	5012	46057	-4.82%
22	0.1	19.77	1070.50	0.07	19.44	3.03	462	4138	-1.64%
22	0.5	4.22	307.60	0.06	3.33	71.26	2265	20638	-21.21%
22	2.0	10.59	405.10	0.07	9.72	899.41	7592	69111	-8.19%
23	0.1	3.28	318.30	0.38	1.59	2.25	327	2887	-51.63%
23	0.5	7.28	415.30	0.31	6.00	38.47	1624	14930	-17.54%
23	2.0	12.72	882.40	0.38	11.80	446.76	5321	48942	-7.20%
24	0.1	7.86	194.20	0.47	1.97	1.71	284	2808	-74.89%
24	0.5	11.52	222.50	0.47	6.71	34.39	1693	14363	-41.78%
24	2.0	16.52	937.60	0.46	12.90	390.05	5275	48162	-21.91%
25	0.1	3.15	359.70	0.63	2.22	2.44	334	2972	-29.57%
25	0.5	7.20	367.70	0.64	6.64	30.15	1605	14245	-7.75%
25	2.0	12.38	765.90	0.64	12.23	331.00	5175	46287	-1.27%
26	0.1	13.31	4289.80	0.24	12.88	3.48	340	3073	-3.24%
26	0.5	2.46	3605.90	0.13	2.43	37.22	1699	14407	-1.23%
26	2.0	7.10	3660.80	0.15	6.65	438.96	5407	49006	-6.28%
27	0.1	2.54	3611.12	0.11	2.39	3.90	362	3210	-5.95%
27	0.5	7.46	3621.85	0.14	7.39	45.69	1662	15390	-0.91%
27	2.0	13.80	3742.81	0.11	13.58	493.45	5519	51196	-1.60%
28	0.1	3.12	3610.67	0.02	2.33	3.31	381	3282	-25.16%
28	0.5	7.78	3620.20	0.11	6.87	41.93	1696	15168	-11.67%
28	2.0	13.42	3720.23	0.12	12.83	429.89	5221	48831	-4.39%
29	0.1	4.75	3617.11	0.01	2.25	2.78	289	2902	-52.62%
29	0.5	9.06	3627.14	0.19	7.30	45.92	1584	15245	-19.43%
29	2.0	15.08	3806.36	0.34	14.03	586.23	5529	50753	-6.93%
30	0.1	1.91	3636.41	0.09	1.84	3.68	363	2885	-3.40%
30	0.5	6.53	3669.47	0.12	6.05	41.04	1612	13863	-7.37%
30	2.0	12.15	4124.58	0.04	11.57	424.40	5041	46431	-4.82%
31	0.1	4.99	3621.79	0.15	2.28	3.67	371	3218	-54.24%
31	0.5	8.88	3642.91	0.14	6.81	43.04	1528	14901	-23.27%
31	2.0	13.96	3846.18	0.47	11.90	511.17	5226	48019	-14.76%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
32	0.1	2.60	3611.40	0.02	2.30	2.83	314	3006	-11.44%
32	0.5	7.14	3668.60	0.04	6.81	42.92	1605	14992	-4.64%
32	2.0	13.52	3797.90	0.05	13.03	481.43	5514	49190	-3.60%
33	0.1	2.43	3623.80	0.14	1.91	3.11	321	3077	-21.40%
33	0.5	13.74	4052.75	0.32	13.57	49.93	1619	15235	-1.25%
33	2.0	7.08	3650.09	0.19	6.92	545.30	5684	50653	-2.28%
34	0.1	2.30	3623.38	0.26	2.22	3.30	355	3198	-3.50%
34	0.5	6.66	3645.66	0.30	6.51	37.78	1590	14725	-2.32%
34	2.0	11.84	4005.65	0.41	11.58	511.82	5139	47087	-2.25%
35	0.1	3.42	3624.27	0.20	2.42	3.19	293	3111	-29.22%
35	0.5	8.62	3650.40	0.17	7.87	47.33	1795	15831	-8.69%
35	2.0	14.95	4096.08	0.20	14.56	584.28	5794	52566	-2.60%
36	0.1	12.32	3999.92	0.17	12.19	3.01	318	2869	-1.06%
36	0.5	2.47	3623.50	0.17	2.41	40.73	1623	14710	-2.56%
36	2.0	6.70	3645.09	0.18	6.28	397.98	4900	46795	-6.20%
37	0.1	12.41	3989.07	0.14	12.15	2.33	322	3112	-2.10%
37	0.5	2.94	3619.58	0.22	2.39	42.25	1661	14322	-18.66%
37	2.0	7.18	3648.72	0.24	7.06	435.43	5370	47135	-1.63%
38	0.1	2.54	3623.76	0.27	2.47	4.09	356	3149	-2.42%
38	0.5	7.56	3644.29	0.14	6.81	44.76	1700	15100	-9.89%
38	2.0	13.71	4044.07	0.15	13.53	555.56	5424	50299	-1.35%
39	0.1	5.30	3619.14	0.09	2.40	3.39	362	3152	-54.66%
39	0.5	9.19	3643.95	0.06	6.98	36.68	1640	14675	-23.98%
39	2.0	14.16	3948.95	0.23	12.82	445.08	5238	48004	-9.45%
40	0.1	4.08	3622.31	0.05	2.33	3.40	339	3135	-42.79%
40	0.5	8.52	3643.58	0.05	7.43	52.08	1819	15630	-12.80%
40	2.0	14.47	4036.42	0.08	13.35	549.98	5664	50458	-7.75%
41	0.1	2.87	3623.80	0.22	2.82	2.79	306	2917	-1.80%
41	0.5	7.61	3648.49	0.28	6.85	41.90	1489	14732	-10.08%
41	2.0	13.54	4012.63	0.79	13.29	563.07	5531	49726	-1.88%
42	0.1	2.65	3623.15	0.01	2.65	3.09	323	3035	-0.19%
42	0.5	8.49	3647.74	0.17	7.00	51.41	1654	15229	-17.59%
42	2.0	14.09	4056.53	0.06	13.81	487.72	5416	49483	-1.95%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
43	0.1	2.33	3623.84	0.06	2.26	2.86	313	2902	-3.15%
43	0.5	13.24	4029.41	0.13	12.97	36.34	1487	14757	-2.04%
43	2.0	6.92	3652.33	0.33	6.85	457.84	5432	49718	-1.04%
44	0.1	14.36	4053.18	0.12	13.64	2.77	307	2850	-5.03%
44	0.5	2.84	3624.77	0.04	2.18	38.20	1625	14737	-23.23%
44	2.0	7.06	3645.63	0.11	6.91	528.58	5683	51919	-2.15%
45	0.1	2.05	3624.75	0.24	1.88	3.20	350	3090	-8.18%
45	0.5	6.45	3644.03	0.24	6.20	41.55	1601	15021	-3.84%
45	2.0	11.93	3980.05	0.24	11.60	410.90	5279	45479	-2.77%
46	0.1	5.00	3617.77	0.15	2.78	3.68	370	3416	-44.41%
46	0.5	9.30	3627.63	0.23	7.12	55.87	1725	15370	-23.37%
46	2.0	15.39	3784.06	0.23	13.82	515.28	5711	51348	-10.20%
47	0.1	2.41	3629.96	0.19	2.07	3.13	344	2970	-13.74%
47	0.5	7.09	3646.86	0.29	6.33	41.53	1540	14317	-10.62%
47	2.0	13.24	3818.03	0.27	12.81	468.59	5573	48445	-3.20%
48	0.1	3.18	3621.90	0.15	2.80	3.53	342	3092	-12.00%
48	0.5	7.81	3638.27	0.21	7.63	51.80	1756	15785	-2.34%
48	2.0	14.55	3947.41	0.11	14.45	548.18	5847	53777	-0.65%
49	0.1	2.50	3616.26	0.21	1.93	3.25	323	3088	-22.98%
49	0.5	7.17	3626.09	0.28	6.48	42.39	1647	14537	-9.56%
49	2.0	12.87	3772.46	0.35	12.75	483.47	5256	49034	-0.92%
50	0.1	4.32	3609.72	0.28	2.18	3.07	303	3152	-49.50%
50	0.5	8.27	3619.02	0.51	6.71	44.86	1507	14612	-18.81%
50	2.0	14.10	3707.72	0.15	11.42	434.35	5343	46459	-19.05%
51	0.1	2.41	3606.90	0.07	2.27	3.61	324	2923	-5.61%
51	0.5	6.92	3665.10	0.21	6.82	50.87	1592	14775	-1.37%
51	2.0	12.74	3809.00	0.11	12.46	432.28	5375	48659	-2.16%
52	0.1	13.76	4018.50	0.15	13.74	4.19	336	3112	-0.17%
52	0.5	2.42	3605.70	0.14	2.15	54.72	1793	15788	-11.43%
52	2.0	7.63	3645.50	0.17	7.04	618.55	5977	53451	-7.78%
53	0.1	3.03	3606.20	0.11	2.43	4.46	332	3251	-19.96%
53	0.5	8.04	3670.30	0.07	7.36	49.91	1751	15692	-8.42%
53	2.0	13.87	4060.70	0.18	13.16	585.97	5715	50252	-5.12%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
54	0.1	3.00	3615.41	0.10	2.27	3.63	346	3014	-24.53%
54	0.5	7.20	3625.83	0.11	7.08	43.44	1599	14957	-1.68%
54	2.0	13.18	3728.00	0.23	13.07	502.49	5224	48638	-0.87%
55	0.1	6.91	3712.40	0.15	6.90	4.25	372	3144	-0.18%
55	0.5	2.60	3607.30	0.15	2.41	53.02	1700	14613	-7.41%
55	2.0	12.65	4086.60	0.07	12.28	432.23	5135	47594	-2.88%
56	0.1	2.55	3615.45	0.19	2.15	3.86	344	3054	-15.67%
56	0.5	7.39	3626.65	0.16	7.17	45.02	1701	15252	-2.94%
56	2.0	13.34	3728.05	0.31	13.32	529.50	5366	50016	-0.14%
57	0.1	13.28	3732.92	0.23	13.01	4.35	337	3057	-2.06%
57	0.5	2.44	3614.02	0.21	2.35	49.70	1587	14798	-3.72%
57	2.0	7.05	3626.84	0.22	6.95	547.73	5465	50063	-1.37%
58	0.1	2.31	3615.57	0.15	2.10	3.94	311	2886	-8.99%
58	0.5	6.86	3626.84	0.14	6.56	49.40	1596	14297	-4.42%
58	2.0	12.57	3748.83	0.16	11.51	481.91	5099	47644	-8.45%
59	0.1	2.44	3616.11	0.23	2.33	4.34	363	3182	-4.51%
59	0.5	7.01	3626.06	0.22	6.52	49.56	1662	14730	-6.99%
59	2.0	12.63	3737.31	0.19	12.31	473.09	5417	47875	-2.54%
60	0.1	2.73	3613.54	0.15	2.05	3.98	310	2894	-24.84%
60	0.5	7.31	3624.66	0.11	6.97	49.24	1673	15145	-4.63%
60	2.0	13.01	3731.27	0.11	12.85	584.50	5696	50439	-1.18%
61	0.1	2.62	3616.25	0.10	2.41	5.26	381	3012	-8.13%
61	0.5	7.53	3626.13	0.08	7.44	52.63	1770	15526	-1.09%
61	2.0	14.07	3742.84	0.07	13.56	520.24	5486	52188	-3.62%
62	0.1	2.54	3610.60	0.08	2.28	3.82	289	2866	-10.17%
62	0.5	7.57	3631.30	0.03	7.19	45.03	1740	15286	-5.10%
62	2.0	13.28	4104.80	0.04	13.16	434.23	5591	50208	-0.90%
63	0.1	2.20	3605.80	0.09	2.16	3.67	321	2957	-1.76%
63	0.5	6.52	3620.10	0.16	6.38	52.23	1627	14820	-2.25%
63	2.0	12.01	4364.50	0.09	11.75	450.73	5628	48084	-2.16%
64	0.1	13.06	3978.80	0.13	12.88	3.70	321	2802	-1.35%
64	0.5	2.71	3609.70	0.13	2.54	45.43	1532	14438	-6.22%
64	2.0	7.49	3742.80	0.11	7.05	446.81	5276	47683	-5.97%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
65	0.1	13.17	3723.88	0.20	12.94	4.25	366	2979	-1.75%
65	0.5	2.52	3615.09	0.13	2.52	47.84	1615	14965	-0.36%
65	2.0	7.38	3624.47	0.24	7.28	506.57	5308	48848	-1.42%
66	0.1	2.80	3615.68	0.04	2.40	4.03	347	3094	-14.14%
66	0.5	7.39	3625.98	0.15	7.05	50.27	1579	15233	-4.62%
66	2.0	13.28	3735.99	0.13	13.07	516.20	5513	48266	-1.53%
67	0.1	2.65	3614.89	0.23	2.62	4.51	326	3113	-0.96%
67	0.5	13.07	3729.23	0.23	13.05	57.94	1736	15594	-0.17%
67	2.0	7.52	3625.88	0.26	7.44	508.44	5289	48578	-1.00%
68	0.1	2.37	3615.71	0.06	1.91	4.01	326	2973	-19.41%
68	0.5	7.35	3625.73	0.13	6.65	49.93	1656	14652	-9.47%
68	2.0	12.83	3737.52	0.12	12.55	474.24	5255	48578	-2.22%
69	0.1	13.05	3754.21	0.12	12.97	3.28	316	3056	-0.66%
69	0.5	2.28	3616.54	0.26	2.27	50.67	1485	15244	-0.80%
69	2.0	7.19	3629.29	0.25	7.13	529.55	5464	49668	-0.92%
70	0.1	2.53	3615.36	0.17	2.50	4.50	341	3220	-1.43%
70	0.5	7.56	3626.31	0.22	7.11	55.38	1661	15499	-6.01%
70	2.0	13.82	3743.85	0.13	13.61	571.95	5888	50099	-1.51%
71	0.1	13.51	3738.69	0.05	11.97	4.03	364	2914	-11.36%
71	0.5	2.65	3615.08	0.17	2.28	46.11	1694	14922	-14.08%
71	2.0	6.79	3625.73	0.14	6.65	483.48	5255	48812	-1.96%
72	0.1	2.68	3615.15	0.09	2.57	3.69	317	2953	-4.26%
72	0.5	6.99	3624.52	0.11	6.93	47.10	1788	15107	-0.97%
72	2.0	13.10	3732.00	0.10	13.01	323.69	5019	49098	-0.72%
73	0.1	2.54	3614.02	0.05	2.36	3.85	304	3178	-7.25%
73	0.5	7.35	3624.74	0.08	7.30	55.48	1784	15973	-0.78%
73	2.0	13.56	3740.45	0.16	13.45	594.90	5687	51306	-0.77%
74	0.1	2.34	3616.30	0.12	2.28	4.55	384	3245	-2.55%
74	0.5	11.91	3721.12	0.14	11.55	47.16	1621	14353	-2.99%
74	2.0	6.77	3626.57	0.04	6.32	583.58	5665	50148	-6.65%
75	0.1	3.05	3623.43	0.11	2.73	4.84	377	3148	-10.61%
75	0.5	8.10	3633.66	0.09	7.73	55.49	1751	15832	-4.58%
75	2.0	14.49	3783.96	0.13	14.25	572.00	5640	51106	-1.63%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
76	0.1	7.94	3622.20	0.08	7.50	4.72	332	3104	-5.52%
76	0.5	14.15	4379.00	0.09	14.02	55.77	1770	16008	-0.96%
76	2.0	2.77	3604.00	0.06	2.70	577.68	5538	51368	-2.58%
77	0.1	2.68	3693.47	0.14	2.37	5.57	342	3000	-11.64%
77	0.5	6.88	3736.54	0.05	6.73	57.22	1822	14901	-2.12%
77	2.0	12.95	4350.05	0.08	12.13	531.47	5166	50034	-6.34%
78	0.1	12.61	4177.40	0.16	12.49	4.92	356	2877	-0.97%
78	0.5	2.61	3611.10	0.18	2.24	50.16	1627	14798	-13.97%
78	2.0	7.32	3742.40	0.03	6.72	230.40	5574	49533	-8.28%
79	0.1	2.83	3692.54	0.10	2.21	4.51	330	2917	-21.96%
79	0.5	6.91	3729.63	0.12	6.66	44.31	1635	14994	-3.70%
79	2.0	12.63	4314.04	0.05	12.03	216.37	5458	47347	-4.74%
80	0.1	2.73	3701.43	0.02	2.23	4.98	323	2946	-18.27%
80	0.5	7.17	3744.79	0.02	6.71	39.85	1713	14601	-6.50%
80	2.0	12.47	4289.95	0.07	11.98	475.01	5357	46987	-3.96%
81	0.1	3.14	3689.92	0.06	2.46	5.22	375	3075	-21.66%
81	0.5	7.75	3729.32	0.11	6.80	46.09	1654	14666	-12.18%
81	2.0	13.01	4312.90	0.09	12.71	549.58	5607	49435	-2.29%
82	0.1	2.72	3693.98	0.13	2.61	5.43	340	3102	-3.99%
82	0.5	7.10	3732.47	0.13	6.98	61.10	1806	15422	-1.64%
82	2.0	13.16	4339.81	0.17	13.11	577.45	5595	49180	-0.34%
83	0.1	12.14	4284.02	0.23	11.82	3.78	361	3195	-2.66%
83	0.5	2.09	3691.56	0.23	2.08	51.24	1637	14789	-0.62%
83	2.0	6.96	3736.75	0.23	6.53	613.80	5561	49080	-6.19%
84	0.1	13.13	4308.74	0.10	12.93	5.12	363	3098	-1.48%
84	0.5	2.75	3689.87	0.12	2.62	49.22	1603	15254	-4.72%
84	2.0	7.27	3737.38	0.06	7.26	492.16	5564	50486	-0.18%
85	0.1	6.95	3736.23	0.16	6.80	4.41	330	3060	-2.07%
85	0.5	2.43	3688.63	0.03	2.30	47.23	1501	14739	-5.00%
85	2.0	12.36	4302.11	0.23	12.27	537.55	5481	48952	-0.76%
86	0.1	2.86	3605.10	0.09	2.47	5.66	393	3181	-13.64%
86	0.5	7.85	3722.30	0.19	7.72	63.34	1769	15723	-1.57%
86	2.0	14.39	3803.20	0.17	13.43	673.41	5855	51983	-6.67%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
87	0.1	6.96	3740.43	0.04	6.95	5.48	356	2933	-0.08%
87	0.5	12.55	4303.91	0.02	12.43	56.05	1648	15043	-0.93%
87	2.0	2.49	3689.67	0.03	2.39	552.17	5466	48276	-4.23%
88	0.1	7.45	3674.20	0.14	7.40	5.50	326	3146	-0.74%
88	0.5	13.60	4234.90	0.15	12.59	61.90	1874	15414	-7.41%
88	2.0	3.03	3609.40	0.15	2.65	619.57	5604	51124	-12.63%
89	0.1	2.62	3685.80	0.11	1.87	5.31	331	3136	-28.73%
89	0.5	7.31	3736.39	0.10	6.93	53.19	1637	15294	-5.20%
89	2.0	12.66	4323.21	0.06	12.59	488.05	5263	47983	-0.61%
90	0.1	7.30	3676.80	0.06	6.50	7.51	349	2965	-11.03%
90	0.5	12.68	3868.80	0.05	12.34	74.67	1675	15257	-2.70%
90	2.0	2.59	3609.30	0.11	2.34	712.85	5473	48406	-9.46%
91	0.1	14.12	4425.62	0.07	13.34	7.62	312	3010	-5.54%
91	0.5	2.97	3693.67	0.08	2.78	86.12	1632	15163	-6.63%
91	2.0	7.84	3738.96	0.12	7.33	799.12	5708	51804	-6.45%
92	0.1	12.83	4317.80	0.13	12.75	8.17	345	3003	-0.58%
92	0.5	2.55	3611.00	0.04	2.44	42.86	1719	15463	-4.32%
92	2.0	7.25	3668.60	0.11	7.08	510.01	5153	49437	-2.37%
93	0.1	2.68	3691.62	0.16	2.67	5.25	330	3016	-0.45%
93	0.5	7.75	3738.43	0.08	7.25	55.62	1719	15167	-6.53%
93	2.0	13.03	4351.22	0.09	12.97	477.87	5456	48364	-0.43%
94	0.1	2.41	3608.00	0.22	2.39	5.19	335	2975	-0.64%
94	0.5	7.62	3725.90	0.19	7.44	52.90	1717	15111	-2.36%
94	2.0	13.29	3835.40	0.03	13.11	229.74	5687	49507	-1.39%
95	0.1	2.97	3694.13	0.11	2.26	5.67	369	3088	-23.93%
95	0.5	7.86	3742.27	0.06	7.22	54.98	1714	15426	-8.14%
95	2.0	13.57	4349.52	0.05	12.89	525.43	5532	49791	-4.99%
96	0.1	2.77	3611.20	0.08	2.71	4.38	314	2875	-2.32%
96	0.5	7.16	3646.30	0.07	7.06	50.65	1692	15050	-1.38%
96	2.0	13.34	4244.40	0.06	13.18	523.26	5600	50335	-1.22%
97	0.1	2.48	3615.60	0.06	2.29	4.54	359	3006	-7.80%
97	0.5	12.61	3924.40	0.21	11.97	57.43	1732	3969	-5.07%
97	2.0	6.90	3632.40	0.12	6.88	457.71	5239	47942	-0.31%

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

Inst	δ	SimExact		SimSA-Expected					GAP (1) x (2)
		E-RPD (1)	CP	D-RPD	E-RPD (2)	CP	NRSS	NRLS	
98	0.1	4.35	3608.94	0.30	2.81	5.57	367	3326	-35.50%
98	0.5	8.62	3637.80	0.30	7.94	56.08	1782	15831	-7.89%
98	2.0	14.90	4134.42	0.30	13.61	558.75	5560	52383	-8.65%
99	0.1	2.40	3611.90	0.01	2.15	3.63	358	3124	-10.20%
99	0.5	7.20	3653.90	0.01	6.77	36.63	1623	15162	-5.97%
99	2.0	12.49	3921.80	0.17	12.43	465.35	5264	48393	-0.55%
100	0.1	3.41	3615.60	0.07	2.43	4.88	314	3004	-28.80%
100	0.5	8.05	3660.50	0.12	7.22	59.52	1647	15230	-10.24%
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	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
1	0.1	19.10	200.30	0.44	18.09	8.06	3307	3307	-5.29%
1	0.5	44.11	342.30	1.07	42.51	27.81	13729	13729	-3.63%
1	2.0	86.96	915.20	0.27	85.52	362.27	46399	46399	-1.66%
2	0.1	21.31	187.00	1.04	18.03	2.60	3014	3014	-15.42%
2	0.5	50.24	214.00	0.78	45.76	40.74	15419	15419	-8.91%
2	2.0	92.69	791.40	0.88	91.74	486.80	51099	51099	-1.03%
3	0.1	22.17	134.10	0.20	20.62	2.45	3699	3699	-6.98%
3	0.5	48.03	240.50	0.19	47.73	38.86	16295	16295	-0.63%
3	2.0	91.23	441.10	0.63	88.21	451.42	49240	49240	-3.31%
4	0.1	21.27	374.80	0.60	20.32	1.92	3245	3245	-4.46%
4	0.5	47.70	458.20	0.60	44.40	36.91	14606	14606	-6.90%
4	2.0	90.63	828.80	0.61	86.19	377.38	46863	46863	-4.89%
5	0.1	18.90	265.40	0.64	18.56	2.30	3038	3038	-1.83%
5	0.5	43.25	276.10	0.41	42.99	32.88	14310	14310	-0.60%
5	2.0	87.91	850.70	0.38	85.54	445.75	46282	46282	-2.70%
6	0.1	20.96	228.40	0.50	19.55	2.26	3304	3304	-6.73%
6	0.5	46.31	297.40	0.30	46.25	36.45	15078	15078	-0.13%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
6	2.0	90.33	974.90	0.71	89.76	454.33	49253	49253	-0.63%
7	0.1	21.85	3604.91	0.23	16.53	1.75	2905	2905	-24.37%
7	0.5	43.80	3617.21	0.17	41.04	27.67	13618	13618	-6.30%
7	2.0	84.74	3770.04	0.44	82.22	413.85	45284	45284	-2.97%
8	0.1	20.94	381.00	0.29	18.74	1.81	3041	3041	-10.52%
8	0.5	48.01	460.90	1.20	44.86	40.77	15768	15768	-6.55%
8	2.0	89.88	1099.90	1.65	88.21	491.79	49611	49611	-1.85%
9	0.1	19.47	346.40	0.35	17.92	2.13	3034	3034	-7.97%
9	0.5	45.77	432.30	0.73	42.41	39.75	14212	14212	-7.35%
9	2.0	85.94	777.40	0.43	85.88	409.47	47773	47773	-0.07%
10	0.1	21.68	265.20	0.54	20.36	2.39	3268	3268	-6.09%
10	0.5	49.53	400.40	1.02	46.38	42.55	14919	14919	-6.35%
10	2.0	89.82	751.20	0.89	89.38	405.55	48055	48055	-0.49%
11	0.1	22.92	366.60	0.44	18.26	2.24	3139	3139	-20.32%
11	0.5	45.54	450.80	0.47	43.93	40.23	14973	14973	-3.54%
11	2.0	88.05	630.90	0.35	86.31	420.67	48334	48334	-1.98%
12	0.1	22.92	168.70	0.36	17.29	1.84	2969	2969	-24.55%
12	0.5	47.01	266.10	0.47	44.66	17.29	14992	14992	-5.00%
12	2.0	89.08	904.60	0.90	87.77	459.10	48127	48127	-1.47%
13	0.1	19.68	285.30	0.94	16.99	1.62	2683	2683	-13.64%
13	0.5	45.63	291.30	0.65	44.75	33.20	14730	14730	-1.93%
13	2.0	89.73	584.70	1.08	89.12	389.23	47567	47567	-0.68%
14	0.1	20.79	342.60	0.34	19.88	2.93	3261	3261	-4.35%
14	0.5	53.83	432.00	1.26	52.67	76.09	19321	19321	-2.16%
14	2.0	116.19	616.70	1.03	111.71	1053.66	68871	68871	-3.86%
15	0.1	17.96	257.20	0.81	17.81	1.93	2935	2935	-0.85%
15	0.5	45.28	325.90	0.00	43.42	32.65	14822	14822	-4.09%
15	2.0	92.45	640.90	1.25	92.05	580.14	52756	52756	-0.44%
16	0.1	22.03	391.40	0.37	18.26	2.57	2874	2874	-17.10%
16	0.5	49.58	467.20	0.24	49.48	46.62	16830	16830	-0.20%
16	2.0	101.54	607.20	0.22	101.14	588.01	58268	58268	-0.39%
17	0.1	23.30	243.80	0.47	18.14	1.71	2968	2968	-22.14%
17	0.5	48.01	309.70	0.93	44.91	39.77	14430	14430	-6.47%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
17	2.0	89.11	710.20	0.42	86.53	368.91	47189	47189	-2.89%
18	0.1	19.57	218.00	0.36	18.07	3.20	3425	3425	-7.64%
18	0.5	46.57	252.40	0.29	45.79	41.26	15340	15340	-1.67%
18	2.0	93.35	813.00	0.22	93.31	497.16	51253	51253	-0.04%
19	0.1	46.89	638.00	0.17	18.06	2.23	3106	3106	-61.49%
19	0.5	90.73	243.20	0.25	45.24	39.49	15602	15602	-50.13%
19	2.0	91.06	359.20	0.27	90.26	476.84	49283	49283	-0.87%
20	0.1	18.74	368.10	0.32	17.88	2.68	2980	2980	-4.60%
20	0.5	42.22	380.20	0.47	41.49	37.17	14052	14052	-1.74%
20	2.0	83.23	879.60	0.16	81.95	321.88	45608	45608	-1.54%
21	0.1	18.03	3607.43	0.59	17.37	2.41	2945	2945	-3.67%
21	0.5	44.07	3626.84	0.79	43.06	32.03	13784	13784	-2.30%
21	2.0	84.00	3844.08	0.64	82.06	288.66	44784	44784	-2.31%
22	0.1	53.88	1070.50	0.36	21.32	3.26	3513	3513	-60.43%
22	0.5	115.70	307.60	0.80	53.88	71.51	18099	18099	-53.43%
22	2.0	115.91	405.10	0.14	114.59	965.39	69347	69347	-1.14%
23	0.1	19.78	318.30	0.59	16.43	2.45	2940	2940	-16.96%
23	0.5	44.56	415.30	0.17	43.35	41.04	14600	14600	-2.72%
23	2.0	87.78	882.40	0.39	85.99	488.24	48375	48375	-2.05%
24	0.1	21.06	194.20	0.47	17.69	1.99	2928	2928	-16.00%
24	0.5	47.67	222.50	1.03	42.77	43.07	14084	14084	-10.27%
24	2.0	88.16	937.60	0.63	87.10	463.23	47667	47667	-1.20%
25	0.1	19.30	359.70	0.81	17.23	2.46	2880	2880	-10.74%
25	0.5	44.37	367.70	1.03	44.21	41.99	14034	14034	-0.34%
25	2.0	84.55	765.90	0.56	84.49	426.70	45848	45848	-0.07%
26	0.1	44.53	4289.80	0.24	17.61	3.71	3035	3035	-60.47%
26	0.5	86.74	3605.90	0.16	43.23	42.85	14604	14604	-50.17%
26	2.0	87.01	3660.80	0.29	86.74	467.25	48444	48444	-0.31%
27	0.1	19.28	3611.12	0.11	19.07	3.71	3371	3371	-1.08%
27	0.5	47.64	3621.85	0.11	46.81	48.62	15285	15285	-1.73%
27	2.0	91.65	3742.81	0.08	91.03	529.30	50727	50727	-0.67%
28	0.1	19.71	3610.67	0.09	18.74	3.56	3381	3381	-4.93%
28	0.5	45.88	3620.20	0.79	44.65	50.93	15391	15391	-2.69%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
28	2.0	87.17	3720.23	0.59	86.87	509.46	48351	48351	-0.35%
29	0.1	20.50	3617.11	0.12	17.90	3.55	2965	2965	-12.73%
29	0.5	46.64	3627.14	0.19	45.52	51.05	14733	14733	-2.39%
29	2.0	91.65	3806.36	0.26	90.24	594.20	50038	50038	-1.54%
30	0.1	17.69	3636.41	0.04	16.98	3.61	3056	3056	-4.03%
30	0.5	43.32	3669.47	0.08	42.53	43.14	14308	14308	-1.84%
30	2.0	83.80	4124.58	0.12	83.27	511.49	46301	46301	-0.63%
31	0.1	19.86	3621.79	0.15	16.92	3.92	3023	3023	-14.80%
31	0.5	45.20	3642.91	0.23	43.38	49.40	14426	14426	-4.02%
31	2.0	86.06	3846.18	0.16	84.55	520.72	47993	47993	-1.76%
32	0.1	18.19	3611.40	0.25	17.74	3.39	3121	3121	-2.46%
32	0.5	45.70	3668.60	0.14	44.98	46.40	15283	15283	-1.57%
32	2.0	88.91	3797.90	0.24	87.98	513.15	49469	49469	-1.05%
33	0.1	18.29	3623.80	0.29	18.19	3.58	3184	3184	-0.56%
33	0.5	90.17	4052.75	0.30	44.63	49.04	15192	15192	-50.51%
33	2.0	90.59	3650.09	0.19	90.17	524.14	50026	50026	-0.46%
34	0.1	18.18	3623.38	0.38	17.60	3.84	3083	3083	-3.20%
34	0.5	44.40	3645.66	0.32	44.13	48.50	14548	14548	-0.60%
34	2.0	85.03	4005.65	0.45	83.23	445.01	45303	45303	-2.11%
35	0.1	20.39	3624.27	0.17	17.87	3.76	2939	2939	-12.32%
35	0.5	47.42	3650.40	0.23	45.99	50.39	15334	15334	-3.01%
35	2.0	95.12	4096.08	0.06	94.21	537.40	52312	52312	-0.96%
36	0.1	43.27	3999.92	0.19	17.23	3.29	2881	2881	-60.17%
36	0.5	84.82	3623.50	0.19	43.27	40.26	14281	14281	-48.98%
36	2.0	85.27	3645.09	0.39	84.82	442.56	46294	46294	-0.53%
37	0.1	43.43	3989.07	0.21	18.16	2.59	3065	3065	-58.17%
37	0.5	85.78	3619.58	0.19	43.43	39.09	14417	14417	-49.37%
37	2.0	84.52	3648.72	0.22	83.79	503.76	47304	47304	-0.86%
38	0.1	18.08	3623.76	0.12	17.95	3.12	3210	3210	-0.73%
38	0.5	45.01	3644.29	0.20	44.62	51.34	15301	15301	-0.87%
38	2.0	91.58	4044.07	0.20	89.42	630.55	50405	50405	-2.36%
39	0.1	20.40	3619.14	0.05	17.67	2.98	2960	2960	-13.40%
39	0.5	45.57	3643.95	0.10	44.30	45.08	14465	14465	-2.78%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
39	2.0	87.06	3948.95	0.03	86.39	474.36	48125	48125	-0.77%
40	0.1	20.42	3622.31	0.78	17.86	2.93	3046	3046	-12.53%
40	0.5	45.56	3643.58	0.81	45.46	49.48	15460	15460	-0.23%
40	2.0	90.40	4036.42	0.91	89.53	384.71	49856	49856	-0.96%
41	0.1	19.03	3623.80	0.34	18.19	3.12	2957	2957	-4.42%
41	0.5	45.79	3648.49	0.28	45.45	42.72	14911	14911	-0.75%
41	2.0	89.46	4012.63	0.31	87.53	471.20	51278	51278	-2.16%
42	0.1	18.65	3623.15	0.82	18.55	3.12	3172	3172	-0.52%
42	0.5	47.67	3647.74	0.31	45.94	55.58	15442	15442	-3.62%
42	2.0	89.92	4056.53	0.01	89.14	489.28	49613	49613	-0.87%
43	0.1	18.55	3623.84	0.16	17.49	2.66	2813	2813	-5.67%
43	0.5	88.20	4029.41	0.07	44.83	31.14	15151	15151	-49.17%
43	2.0	88.56	3652.33	0.15	87.89	462.27	48560	48560	-0.76%
44	0.1	45.44	4053.18	0.11	17.55	2.68	2762	2762	-61.37%
44	0.5	91.36	3624.77	0.14	43.88	44.80	14991	14991	-51.97%
44	2.0	92.10	3645.63	0.14	91.13	578.47	51126	51126	-1.05%
45	0.1	17.85	3624.75	0.60	17.42	2.92	3078	3078	-2.40%
45	0.5	42.78	3644.03	0.49	42.74	33.05	14315	14315	-0.09%
45	2.0	83.56	3980.05	0.51	83.24	430.14	46211	46211	-0.38%
46	0.1	20.26	3617.77	0.12	19.87	3.26	3458	3458	-1.93%
46	0.5	47.21	3627.63	0.18	46.11	50.81	15526	15526	-2.33%
46	2.0	92.39	3784.06	0.28	92.02	576.61	52166	52166	-0.40%
47	0.1	18.27	3629.96	0.39	17.79	2.88	2901	2901	-2.65%
47	0.5	44.76	3646.86	0.24	43.43	48.50	14858	14858	-2.97%
47	2.0	88.73	3818.03	0.40	87.20	556.91	48379	48379	-1.73%
48	0.1	19.68	3621.90	0.15	17.77	2.98	2938	2938	-9.70%
48	0.5	46.88	3638.27	0.25	46.27	48.93	15616	15616	-1.31%
48	2.0	94.38	3947.41	0.22	93.87	624.30	52547	52547	-0.54%
49	0.1	18.36	3616.26	0.32	18.24	3.23	3159	3159	-0.67%
49	0.5	44.99	3626.09	0.23	44.14	41.50	14673	14673	-1.88%
49	2.0	88.13	3772.46	0.32	88.05	514.46	48483	48483	-0.10%
50	0.1	18.50	3609.72	0.39	18.45	3.54	3153	3153	-0.28%
50	0.5	45.32	3619.02	0.33	43.25	45.06	14459	14459	-4.57%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
50	2.0	85.12	3707.72	0.46	85.07	538.39	47582	47582	-0.07%
51	0.1	17.45	3606.90	0.20	17.04	4.25	2794	2794	-2.35%
51	0.5	44.83	3665.10	0.19	44.75	54.99	14736	14736	-0.18%
51	2.0	87.45	3809.00	0.35	86.82	493.50	47741	47741	-0.72%
52	0.1	45.69	4018.50	0.18	17.41	5.56	3049	3049	-61.90%
52	0.5	92.00	3605.70	0.17	45.69	62.44	15288	15288	-50.34%
52	2.0	92.65	3645.50	0.17	91.84	641.25	52552	52552	-0.88%
53	0.1	19.72	3606.20	0.19	18.74	6.36	3088	3088	-4.99%
53	0.5	46.82	3670.30	0.19	46.37	68.38	15481	15481	-0.95%
53	2.0	90.81	4060.70	0.16	90.20	684.60	50871	50871	-0.67%
54	0.1	19.56	3615.41	0.19	18.35	5.46	3116	3116	-6.20%
54	0.5	44.93	3625.83	0.18	44.58	61.73	14746	14746	-0.79%
54	2.0	87.51	3728.00	0.19	86.91	537.13	47441	47441	-0.68%
55	0.1	44.14	3712.40	0.08	17.67	4.91	2985	2985	-59.96%
55	0.5	44.80	3607.30	0.18	44.09	57.76	14869	14869	-1.58%
55	2.0	87.92	4086.60	0.13	87.44	583.15	49670	49670	-0.54%
56	0.1	18.37	3615.45	0.47	17.60	4.52	3011	3011	-4.22%
56	0.5	46.41	3626.65	0.34	45.21	61.31	15200	15200	-2.58%
56	2.0	88.70	3728.05	0.19	88.19	563.32	49278	49278	-0.57%
57	0.1	45.66	3732.92	0.23	17.57	4.47	2998	2998	-61.52%
57	0.5	89.22	3614.02	0.22	45.65	58.86	15037	15037	-48.84%
57	2.0	88.70	3626.84	0.20	87.97	539.24	50037	50037	-0.83%
58	0.1	17.44	3615.57	0.14	17.35	4.22	2877	2877	-0.53%
58	0.5	44.47	3626.84	0.18	43.54	57.13	14205	14205	-2.09%
58	2.0	86.34	3748.83	0.14	84.95	593.23	47321	47321	-1.61%
59	0.1	17.88	3616.11	0.23	17.85	5.68	2960	2960	-0.18%
59	0.5	44.67	3626.06	0.18	44.58	54.03	15094	15094	-0.21%
59	2.0	86.80	3737.31	0.32	85.22	600.64	48074	48074	-1.82%
60	0.1	19.33	3613.54	0.18	18.49	5.30	3132	3132	-4.34%
60	0.5	46.08	3624.66	0.03	44.32	48.95	14916	14916	-3.82%
60	2.0	88.66	3731.27	0.18	87.59	636.23	49343	49343	-1.21%
61	0.1	19.23	3616.25	0.07	18.71	4.81	3158	3158	-2.73%
61	0.5	46.81	3626.13	0.12	45.64	58.39	15487	15487	-2.49%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
61	2.0	91.79	3742.84	0.09	91.17	690.30	52049	52049	-0.67%
62	0.1	17.99	3610.60	0.08	17.74	4.76	2976	2976	-1.41%
62	0.5	45.90	3631.30	0.09	45.22	44.34	14954	14954	-1.49%
62	2.0	90.28	4104.80	0.27	89.15	745.33	50721	50721	-1.26%
63	0.1	17.61	3605.80	0.47	17.41	4.17	2884	2884	-1.16%
63	0.5	43.65	3620.10	0.26	43.31	53.88	14755	14755	-0.77%
63	2.0	86.92	4364.50	0.25	85.50	568.64	48856	48856	-1.63%
64	0.1	44.57	3978.80	0.25	18.26	5.15	3047	3047	-59.03%
64	0.5	88.24	3609.70	0.23	44.57	63.34	14772	14772	-49.49%
64	2.0	86.89	3742.80	0.07	86.13	557.31	49494	49494	-0.88%
65	0.1	43.72	3723.88	0.20	18.58	4.82	3154	3154	-57.49%
65	0.5	87.26	3615.09	0.20	43.72	46.02	14710	14710	-49.90%
65	2.0	87.42	3624.47	0.15	87.26	602.41	49551	49551	-0.18%
66	0.1	19.11	3615.68	0.13	18.24	4.64	3139	3139	-4.58%
66	0.5	45.75	3625.98	0.16	45.14	51.72	15116	15116	-1.33%
66	2.0	88.08	3735.99	0.18	87.96	564.57	48373	48373	-0.14%
67	0.1	18.95	3614.89	0.25	18.62	5.42	3201	3201	-1.73%
67	0.5	89.09	3729.23	0.17	45.86	52.47	15348	15348	-48.52%
67	2.0	89.27	3625.88	0.34	88.39	664.75	48873	48873	-0.98%
68	0.1	17.76	3615.71	0.17	17.48	4.23	2819	2819	-1.58%
68	0.5	44.46	3625.73	0.16	44.32	53.39	14640	14640	-0.32%
68	2.0	88.59	3737.52	0.33	86.43	607.93	48388	48388	-2.43%
69	0.1	45.85	3754.21	0.22	18.10	5.00	3297	3297	-60.51%
69	0.5	89.36	3616.54	0.23	45.85	66.99	15773	15773	-48.70%
69	2.0	89.95	3629.29	0.13	89.36	267.64	50191	50191	-0.65%
70	0.1	18.61	3615.36	0.17	18.13	4.45	3152	3152	-2.58%
70	0.5	45.49	3626.31	0.14	45.29	57.18	15048	15048	-0.44%
70	2.0	91.06	3743.85	0.16	89.23	637.18	49317	49317	-2.01%
71	0.1	45.02	3738.69	0.27	18.05	4.51	3110	3110	-59.89%
71	0.5	88.76	3615.08	0.88	45.02	46.54	14854	14854	-49.28%
71	2.0	86.96	3625.73	0.16	86.04	552.72	49796	49796	-1.05%
72	0.1	18.47	3615.15	0.23	18.28	4.41	3048	3048	-1.00%
72	0.5	44.53	3624.52	0.15	44.29	40.32	14621	14621	-0.52%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
72	2.0	87.73	3732.00	0.24	86.35	586.00	48935	48935	-1.57%
73	0.1	19.01	3614.02	0.09	17.19	4.48	2923	2923	-9.57%
73	0.5	46.75	3624.74	0.08	45.83	53.43	15295	15295	-1.97%
73	2.0	91.55	3740.45	0.10	90.16	594.08	50870	50870	-1.52%
74	0.1	17.64	3616.30	0.13	16.16	4.59	2704	2704	-8.38%
74	0.5	84.86	3721.12	0.07	43.45	47.45	14662	14662	-48.80%
74	2.0	83.79	3626.57	0.17	82.98	558.92	47061	47061	-0.97%
75	0.1	19.72	3623.43	0.11	18.91	5.14	3167	3167	-4.12%
75	0.5	47.34	3633.66	0.10	46.90	64.89	15806	15806	-0.92%
75	2.0	93.15	3783.96	0.21	92.25	777.65	51659	51659	-0.97%
76	0.1	90.65	3622.20	0.10	18.48	6.32	3127	3127	-79.62%
76	0.5	47.23	4379.00	0.09	46.39	58.58	15681	15681	-1.78%
76	2.0	90.73	3604.00	0.06	90.65	615.36	50446	50446	-0.09%
77	0.1	18.69	3693.47	0.10	17.20	5.67	2900	2900	-7.96%
77	0.5	45.52	3736.54	0.07	44.50	59.18	14886	14886	-2.25%
77	2.0	87.83	4350.05	0.18	86.81	582.74	48753	48753	-1.17%
78	0.1	44.94	4177.40	0.11	18.19	5.18	3050	3050	-59.52%
78	0.5	88.27	3611.10	0.15	44.94	53.09	14893	14893	-49.09%
78	2.0	86.85	3742.40	0.16	85.99	551.26	48764	48764	-0.99%
79	0.1	19.35	3692.54	0.15	17.23	5.26	2878	2878	-10.95%
79	0.5	44.83	3729.63	0.08	44.56	52.29	15014	15014	-0.59%
79	2.0	87.62	4314.04	0.25	87.60	569.99	49812	49812	-0.02%
80	0.1	18.88	3701.43	0.12	16.87	5.69	2963	2963	-10.64%
80	0.5	44.85	3744.79	0.08	44.71	55.18	14804	14804	-0.30%
80	2.0	85.71	4289.95	0.00	84.66	508.94	48027	48027	-1.23%
81	0.1	18.82	3689.92	0.04	17.97	5.34	2941	2941	-4.53%
81	0.5	45.28	3729.32	0.08	45.21	54.01	14869	14869	-0.16%
81	2.0	87.40	4312.90	0.21	86.99	622.38	48299	48299	-0.46%
82	0.1	18.32	3693.98	0.76	17.69	5.86	3025	3025	-3.41%
82	0.5	46.39	3732.47	0.66	45.47	60.09	15342	15342	-1.98%
82	2.0	88.23	4339.81	0.60	88.10	625.62	49473	49473	-0.15%
83	0.1	44.33	4284.02	0.54	17.31	5.84	3021	3021	-60.96%
83	0.5	86.08	3691.56	0.60	44.33	58.59	15018	15018	-48.51%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
83	2.0	86.37	3736.75	0.71	86.08	606.90	48571	48571	-0.33%
84	0.1	45.60	4308.74	0.12	18.43	5.30	3010	3010	-59.58%
84	0.5	88.88	3689.87	0.23	45.60	61.45	15068	15068	-48.70%
84	2.0	88.60	3737.38	0.17	87.78	593.95	49467	49467	-0.92%
85	0.1	44.88	3736.23	0.31	18.11	5.49	3234	3234	-59.65%
85	0.5	45.01	3688.63	0.23	44.37	58.52	14892	14892	-1.43%
85	2.0	86.99	4302.11	0.24	85.63	501.07	47315	47315	-1.56%
86	0.1	19.05	3605.10	0.15	17.84	5.14	3001	3001	-6.38%
86	0.5	47.58	3722.30	0.17	47.43	78.49	16123	16123	-0.30%
86	2.0	94.17	3803.20	0.17	93.96	766.93	53910	53910	-0.23%
87	0.1	86.94	3740.43	0.09	17.34	5.83	2869	2869	-80.05%
87	0.5	44.80	4303.91	0.77	44.23	56.92	14549	14549	-1.29%
87	2.0	87.72	3689.67	0.70	86.85	596.05	48768	48768	-1.00%
88	0.1	90.94	3674.20	0.18	19.29	6.13	3295	3295	-78.79%
88	0.5	46.50	4234.90	0.15	46.13	65.98	15541	15541	-0.80%
88	2.0	88.85	3609.40	0.12	87.97	656.32	51275	51275	-0.98%
89	0.1	18.93	3685.80	0.09	18.35	5.44	3182	3182	-3.06%
89	0.5	45.97	3736.39	0.11	45.52	58.72	15356	15356	-0.98%
89	2.0	86.22	4323.21	0.03	86.17	637.78	50215	50215	-0.06%
90	0.1	88.22	3676.80	0.10	17.96	5.15	2971	2971	-79.64%
90	0.5	44.55	3868.80	0.04	44.54	52.73	14971	14971	-0.03%
90	2.0	87.37	3609.30	0.16	86.67	550.98	49571	49571	-0.80%
91	0.1	46.09	4425.62	0.06	17.93	5.12	3056	3056	-61.10%
91	0.5	91.96	3693.67	0.09	46.09	68.99	15372	15372	-49.88%
91	2.0	90.88	3738.96	0.06	89.91	663.24	51255	51255	-1.07%
92	0.1	45.50	4317.80	0.16	18.60	5.67	3168	3168	-59.12%
92	0.5	87.60	3611.00	0.10	45.38	65.52	15211	15211	-48.19%
92	2.0	88.41	3668.60	0.09	87.51	550.66	48894	48894	-1.02%
93	0.1	19.10	3691.62	0.16	18.12	5.12	2880	2880	-5.08%
93	0.5	46.56	3738.43	0.11	46.25	57.99	15484	15484	-0.68%
93	2.0	88.36	4351.22	0.01	88.14	637.28	49713	49713	-0.25%
94	0.1	18.47	3608.00	0.13	18.00	5.55	3068	3068	-2.57%
94	0.5	46.05	3725.90	0.28	45.40	60.09	15331	15331	-1.43%

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

Inst	δ	SimExact		SimSA-VaR					GAP (1) x (2)
		V-RPD (1)	CP	D-RPD	V-RPD (2)	CP	NRSS	NRLS	
94	2.0	89.09	3835.40	0.23	88.81	549.72	49672	49672	-0.30%
95	0.1	20.51	3694.13	0.05	17.59	5.10	3022	3022	-14.22%
95	0.5	46.69	3742.27	0.15	46.47	67.73	15520	15520	-0.46%
95	2.0	89.51	4349.52	0.15	89.03	623.46	50799	50799	-0.53%
96	0.1	18.60	3611.20	0.05	18.04	4.93	2937	2937	-3.01%
96	0.5	46.32	3646.30	0.12	46.05	61.03	15143	15143	-0.58%
96	2.0	90.64	4244.40	0.13	88.68	609.56	50656	50656	-2.17%
97	0.1	18.34	3615.60	0.09	17.09	5.39	2944	2944	-6.82%
97	0.5	86.65	3824.40	0.11	44.71	53.53	15087	15087	-48.40%
97	2.0	85.81	3632.40	0.28	85.04	485.82	48133	48133	-0.91%
98	0.1	19.88	3608.94	0.62	17.83	5.77	3041	3041	-10.31%
98	0.5	47.34	3637.80	0.54	46.35	64.97	15502	15502	-2.10%
98	2.0	91.67	4134.42	0.72	89.29	573.78	51503	51503	-2.59%
99	0.1	17.88	3611.90	0.70	16.83	4.88	2923	2923	-5.91%
99	0.5	44.80	3653.90	0.34	44.72	61.16	14788	14788	-0.20%
99	2.0	86.44	3721.80	0.30	85.24	507.14	48295	48295	-1.39%
100	0.1	19.12	3615.60	0.16	17.93	5.56	3087	3087	-6.20%
100	0.5	45.38	3660.50	0.06	45.10	57.20	15074	15074	-0.62%
100	2.0	85.14	4045.80	0.66	84.85	580.48	47682	47682	-0.34%

3. SimSA-CVaR X SimExact

Table 3: Result of SimExact x SimSA-CVaR

Inst	δ	SimExact		SimSA-CVaR					GAP (1) x (2)
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
1	0.1	23.57	200.30	1.03	21.84	9.64	305	2844	-7.33%
1	0.5	57.35	342.30	0.66	55.64	22.29	1543	14492	-2.99%
1	2.0	113.95	915.20	0.34	113.09	375.56	5565	47599	-0.76%
2	0.1	26.06	187.00	0.72	23.55	2.45	353	3075	-9.64%
2	0.5	64.12	214.00	1.18	57.91	45.48	1633	14882	-9.69%
2	2.0	121.05	791.40	1.02	119.20	544.21	5572	50349	-1.52%
3	0.1	26.98	134.10	0.29	26.04	2.60	394	3712	-3.47%
3	0.5	61.31	240.50	0.60	60.13	46.33	1814	15992	-1.93%

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

Inst	δ	SimExact		SimSA-CVaR					GAP
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
3	2.0	117.67	441.10	0.23	116.01	325.86	5499	49453	-1.41%
4	0.1	26.32	374.80	1.16	25.08	3.16	375	3211	-4.72%
4	0.5	60.33	458.20	0.59	56.47	43.10	1701	14921	-6.41%
4	2.0	117.38	828.80	0.65	114.36	420.50	5426	48486	-2.57%
5	0.1	23.53	265.40	0.45	22.82	2.04	318	2989	-3.02%
5	0.5	56.53	276.10	0.64	54.99	38.20	1563	14480	-2.72%
5	2.0	115.60	850.70	0.32	113.52	405.36	5212	47789	-1.79%
6	0.1	25.37	228.40	0.36	24.35	2.65	378	3366	-4.03%
6	0.5	59.80	297.40	0.39	59.65	34.08	1591	15365	-0.25%
6	2.0	117.51	974.90	0.74	117.33	416.49	5437	48954	-0.15%
7	0.1	26.51	3604.91	0.41	21.42	2.25	290	2920	-19.19%
7	0.5	55.74	3617.21	0.36	55.10	35.66	1550	14075	-1.13%
7	2.0	111.12	3770.04	0.12	106.05	330.65	4933	44920	-4.56%
8	0.1	25.67	381.00	0.14	22.85	2.01	373	3128	-11.00%
8	0.5	60.57	460.90	0.55	56.52	36.59	1562	14996	-6.70%
8	2.0	115.77	1099.90	0.86	113.71	431.64	5401	48660	-1.78%
9	0.1	24.38	346.40	0.71	22.75	2.32	310	3078	-6.70%
9	0.5	59.71	432.30	0.55	55.86	38.05	1501	14228	-6.46%
9	2.0	113.01	777.40	0.20	112.15	396.45	5130	47772	-0.75%
10	0.1	27.17	265.20	0.66	24.62	2.40	410	3210	-9.38%
10	0.5	62.51	400.40	1.05	59.80	46.44	1547	14972	-4.32%
10	2.0	116.07	751.20	0.80	115.98	396.71	5283	48006	-0.07%
11	0.1	27.21	366.60	0.23	22.56	1.81	312	3217	-17.10%
11	0.5	57.78	450.80	0.39	57.43	37.69	1687	15088	-0.60%
11	2.0	116.61	630.90	0.27	114.01	408.31	5447	49315	-2.23%
12	0.1	27.05	168.70	0.40	23.01	1.84	321	3078	-14.93%
12	0.5	59.59	266.10	0.36	58.00	39.24	1583	15118	-2.66%
12	2.0	116.16	904.60	0.27	115.87	443.03	5660	50169	-0.25%
13	0.1	24.33	285.30	0.61	22.73	1.56	293	2861	-6.58%
13	0.5	58.27	291.30	1.01	57.47	35.46	1697	15087	-1.37%
13	2.0	119.17	584.70	0.46	118.22	415.68	5436	49151	-0.80%
14	0.1	28.44	342.60	0.57	25.51	3.41	446	3732	-10.29%
14	0.5	71.88	432.00	1.04	68.93	73.18	2170	19333	-4.10%

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

Inst	δ	SimExact		SimSA-CVaR					GAP
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
14	2.0	157.07	616.70	0.34	153.62	919.11	7672	68669	-2.20%
15	0.1	23.54	257.20	0.02	22.27	2.31	399	3101	-5.42%
15	0.5	57.99	325.90	0.99	57.92	33.16	1644	14686	-0.12%
15	2.0	121.23	640.90	1.47	118.28	542.63	5754	51278	-2.43%
16	0.1	27.52	391.40	0.39	24.01	2.59	327	2945	-12.74%
16	0.5	63.42	467.20	0.32	63.23	47.50	1769	16092	-0.30%
16	2.0	136.15	607.20	0.45	134.04	710.62	6296	58454	-1.55%
17	0.1	27.96	243.80	0.49	22.70	2.12	344	2953	-18.80%
17	0.5	60.01	309.70	0.82	56.11	33.29	1620	14689	-6.49%
17	2.0	115.15	710.20	0.66	114.04	406.38	5022	46078	-0.97%
18	0.1	24.21	218.00	0.09	23.10	2.73	340	3138	-4.59%
18	0.5	60.96	252.40	0.14	60.19	41.13	1802	15522	-1.26%
18	2.0	122.13	813.00	0.30	120.82	457.46	5573	50861	-1.07%
19	0.1	58.83	638.00	0.56	22.31	2.43	341	2929	-62.07%
19	0.5	119.14	243.20	0.72	58.33	44.35	1631	14819	-51.04%
19	2.0	119.14	359.20	0.36	119.14	426.99	5631	49696	0.00%
20	0.1	23.34	368.10	0.35	22.88	2.31	356	3097	-1.97%
20	0.5	54.89	380.20	0.31	54.18	30.51	1555	14077	-1.29%
20	2.0	108.99	879.60	0.06	108.43	345.60	4997	45764	-0.51%
21	0.1	23.04	3607.43	0.05	21.31	1.84	275	3016	-7.51%
21	0.5	56.57	3626.84	0.10	55.40	29.75	1573	13812	-2.07%
21	2.0	109.83	3844.08	0.37	109.67	404.15	5067	44881	-0.15%
22	0.1	72.77	1070.50	0.29	28.05	3.81	371	3700	-61.45%
22	0.5	151.85	307.60	0.96	72.77	86.84	2146	18890	-52.08%
22	2.0	152.96	405.10	0.11	151.85	864.44	7049	66326	-0.73%
23	0.1	24.46	318.30	0.54	21.62	2.44	345	2912	-11.61%
23	0.5	58.00	415.30	0.56	54.99	36.07	1548	13919	-5.19%
23	2.0	115.42	882.40	0.37	112.61	455.33	5516	47553	-2.44%
24	0.1	25.13	194.20	0.70	23.18	2.38	329	2990	-7.77%
24	0.5	60.16	222.50	0.69	55.62	31.85	1605	14507	-7.53%
24	2.0	114.42	937.60	0.47	113.07	379.11	5470	47618	-1.18%
25	0.1	24.23	359.70	0.47	21.75	1.74	282	2892	-10.24%
25	0.5	57.36	367.70	0.87	56.63	40.68	1583	14406	-1.28%

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

Inst	δ	SimExact		SimSA-CVaR					GAP
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
25	2.0	110.16	765.90	0.55	109.77	374.81	5055	45576	-0.36%
26	0.1	57.82	4289.80	0.28	22.17	3.04	297	2998	-61.65%
26	0.5	118.48	3605.90	0.18	55.72	36.98	1595	14753	-52.97%
26	2.0	118.63	3660.80	0.34	117.90	494.72	5436	48796	-0.62%
27	0.1	24.24	3611.12	0.12	24.09	3.19	332	3253	-0.63%
27	0.5	61.06	3621.85	0.21	60.18	52.00	1805	15617	-1.44%
27	2.0	121.37	3742.81	0.16	121.02	586.01	5709	50214	-0.28%
28	0.1	24.81	3610.67	0.21	22.96	3.62	278	3052	-7.47%
28	0.5	58.13	3620.20	0.65	58.03	52.23	1633	15284	-0.19%
28	2.0	115.57	3720.23	0.69	115.15	494.36	5452	48789	-0.36%
29	0.1	24.88	3617.11	0.19	22.26	3.14	257	2726	-10.52%
29	0.5	59.92	3627.14	0.17	59.50	50.63	1595	15000	-0.70%
29	2.0	122.83	3806.36	0.19	121.85	603.06	5852	51868	-0.80%
30	0.1	21.82	3636.41	0.08	21.20	3.81	345	2927	-2.85%
30	0.5	56.37	3669.47	0.05	54.53	43.44	1580	13987	-3.27%
30	2.0	112.77	4124.58	0.01	110.35	445.45	5050	45565	-2.15%
31	0.1	24.47	3621.79	0.12	22.09	3.55	346	2899	-9.70%
31	0.5	58.48	3642.91	0.20	56.44	46.62	1625	14589	-3.48%
31	2.0	114.83	3846.18	0.19	114.04	518.67	5281	47480	-0.68%
32	0.1	22.89	3611.40	0.21	22.22	3.21	344	3054	-2.94%
32	0.5	58.84	3668.60	0.33	57.88	51.64	1647	14524	-1.62%
32	2.0	118.74	3797.90	0.14	118.26	471.03	5220	49084	-0.41%
33	0.1	22.63	3623.80	0.34	22.39	4.05	383	3034	-1.07%
33	0.5	119.83	4052.75	0.13	58.28	42.25	1598	15081	-51.36%
33	2.0	120.40	3650.09	0.18	119.83	538.73	5681	50342	-0.47%
34	0.1	22.53	3623.38	0.30	22.37	3.62	302	2982	-0.73%
34	0.5	56.39	3645.66	0.36	56.00	49.05	1665	14516	-0.69%
34	2.0	114.66	4005.65	0.43	113.11	542.21	5362	47912	-1.35%
35	0.1	25.42	3624.27	0.13	22.98	3.23	303	2931	-9.62%
35	0.5	61.88	3650.40	0.15	61.87	50.88	1689	15679	-0.02%
35	2.0	126.83	4096.08	0.15	125.28	441.18	5833	52589	-1.23%
36	0.1	56.74	3999.92	0.19	22.09	3.19	272	2862	-61.08%
36	0.5	110.40	3623.50	0.24	56.74	42.09	1603	14263	-48.60%

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

Inst	δ	SimExact		SimSA-CVaR					GAP
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
36	2.0	113.40	3645.09	0.19	110.40	445.82	5141	45802	-2.65%
37	0.1	56.73	3989.07	0.20	20.72	2.85	281	2726	-63.47%
37	0.5	113.32	3619.58	0.27	56.73	45.91	1592	14609	-49.94%
37	2.0	113.95	3648.72	0.34	113.28	517.96	5183	46729	-0.59%
38	0.1	23.01	3623.76	0.19	22.22	3.70	313	3045	-3.43%
38	0.5	58.30	3644.29	0.14	57.10	49.80	1732	15130	-2.05%
38	2.0	119.26	4044.07	0.09	119.16	545.25	5383	49572	-0.08%
39	0.1	25.08	3619.14	0.72	23.13	3.56	360	3108	-7.77%
39	0.5	58.58	3643.95	0.06	56.54	41.49	1490	14195	-3.48%
39	2.0	116.20	3948.95	0.84	114.87	468.02	5253	47826	-1.14%
40	0.1	25.38	3622.31	0.02	23.11	3.45	310	3109	-8.95%
40	0.5	59.23	3643.58	0.73	59.04	53.11	1732	15397	-0.33%
40	2.0	120.93	4036.42	0.02	120.77	467.71	5773	50935	-0.14%
41	0.1	24.06	3623.80	0.28	22.59	3.17	276	2957	-6.14%
41	0.5	58.75	3648.49	0.19	58.60	46.57	1630	15103	-0.25%
41	2.0	119.17	4012.63	0.42	116.61	569.43	5438	50404	-2.15%
42	0.1	24.12	3623.15	0.69	23.84	3.68	311	3238	-1.17%
42	0.5	60.92	3647.74	0.30	59.02	55.52	1750	15294	-3.13%
42	2.0	119.96	4056.53	0.13	119.86	540.35	5658	50276	-0.09%
43	0.1	22.84	3623.84	0.16	22.03	3.39	338	2854	-3.56%
43	0.5	117.06	4029.41	0.15	56.55	43.36	1593	14161	-51.69%
43	2.0	117.70	3652.33	0.19	117.00	569.94	5651	48426	-0.60%
44	0.1	59.95	4053.18	0.09	22.16	3.15	309	2915	-63.04%
44	0.5	122.81	3624.77	0.09	56.38	42.87	1579	15063	-54.09%
44	2.0	123.08	3645.63	0.14	122.27	551.72	5457	51143	-0.66%
45	0.1	22.33	3624.75	0.36	20.89	2.52	283	2882	-6.43%
45	0.5	55.83	3644.03	0.48	55.04	46.01	1587	14280	-1.41%
45	2.0	111.53	3980.05	0.33	111.31	468.28	5072	47259	-0.19%
46	0.1	24.77	3617.77	0.14	23.85	3.94	372	3280	-3.74%
46	0.5	61.25	3627.63	0.12	59.56	55.39	1751	15380	-2.76%
46	2.0	123.54	3784.06	0.14	123.24	571.01	5706	51793	-0.25%
47	0.1	22.86	3629.96	0.25	21.92	3.00	314	2870	-4.10%
47	0.5	58.93	3646.86	0.23	57.13	41.14	1531	14388	-3.05%

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

Inst	δ	SimExact		SimSA-CVaR					GAP (1) x (2)
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
47	2.0	116.84	3818.03	0.20	114.74	433.89	5144	47409	-1.80%
48	0.1	25.08	3621.90	0.18	23.74	3.26	359	3124	-5.36%
48	0.5	61.32	3638.27	0.28	59.74	46.33	1673	15085	-2.56%
48	2.0	125.41	3947.41	0.19	124.85	588.38	5930	52314	-0.45%
49	0.1	23.58	3616.26	0.33	22.76	3.41	300	3085	-3.47%
49	0.5	58.45	3626.09	0.22	56.67	45.33	1647	14535	-3.04%
49	2.0	117.32	3772.46	0.38	117.14	570.32	5525	49062	-0.15%
50	0.1	23.27	3609.72	0.34	23.19	4.18	384	3269	-0.34%
50	0.5	58.03	3619.02	0.32	56.63	44.22	1558	14473	-2.40%
50	2.0	113.35	3707.72	0.36	112.73	470.13	4939	46545	-0.55%
51	0.1	22.94	3606.90	0.10	22.02	4.25	314	2946	-4.02%
51	0.5	58.10	3665.10	0.18	57.81	48.96	1514	14516	-0.49%
51	2.0	117.98	3809.00	0.41	117.85	517.57	5312	47984	-0.11%
52	0.1	60.46	4018.50	0.21	23.33	5.37	345	3164	-61.41%
52	0.5	125.08	3605.70	0.17	60.46	58.78	1662	15694	-51.66%
52	2.0	125.16	3645.50	0.26	124.34	709.08	5972	52025	-0.65%
53	0.1	24.90	3606.20	0.12	22.52	4.86	331	3055	-9.56%
53	0.5	59.90	3670.30	0.23	59.43	65.99	1670	15008	-0.78%
53	2.0	123.05	4060.70	0.23	122.79	683.55	5540	51548	-0.21%
54	0.1	24.22	3615.41	0.22	21.72	4.14	258	2987	-10.33%
54	0.5	57.96	3625.83	0.20	57.95	56.18	1624	14725	-0.02%
54	2.0	117.61	3728.00	0.29	116.73	550.10	5517	48808	-0.76%
55	0.1	58.20	3712.40	0.05	21.86	4.33	378	2880	-62.43%
55	0.5	58.28	3607.30	0.09	57.60	49.40	1597	14570	-1.16%
55	2.0	118.84	4086.60	0.16	117.76	589.24	5224	47944	-0.91%
56	0.1	23.66	3615.45	0.40	23.12	5.28	339	3091	-2.26%
56	0.5	60.05	3626.65	0.28	59.38	58.89	1632	14975	-1.12%
56	2.0	119.70	3728.05	0.22	119.20	542.97	5500	49658	-0.42%
57	0.1	59.72	3732.92	0.20	22.92	5.02	351	2975	-61.62%
57	0.5	120.53	3614.02	0.11	59.52	59.66	1757	15241	-50.62%
57	2.0	119.53	3626.84	0.22	118.67	606.57	5642	49836	-0.72%
58	0.1	22.60	3615.57	0.27	22.19	4.78	258	2912	-1.85%
58	0.5	57.60	3626.84	0.28	56.84	57.86	1577	14112	-1.32%

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

Inst	δ	SimExact		SimSA-CVaR					GAP
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
58	2.0	116.78	3748.83	0.24	116.43	461.31	5156	47785	-0.30%
59	0.1	22.76	3616.11	0.27	22.11	5.01	371	3042	-2.82%
59	0.5	57.90	3626.06	0.33	57.31	57.02	1665	14471	-1.02%
59	2.0	116.61	3737.31	0.31	116.53	522.40	5459	48033	-0.07%
60	0.1	23.96	3613.54	0.14	21.35	4.47	308	2820	-10.92%
60	0.5	59.56	3624.66	0.20	59.01	52.27	1662	15031	-0.92%
60	2.0	120.43	3731.27	0.13	119.18	578.17	5505	50331	-1.04%
61	0.1	24.01	3616.25	0.16	22.35	5.08	317	3047	-6.90%
61	0.5	62.07	3626.13	0.07	60.91	58.34	1739	15780	-1.87%
61	2.0	124.75	3742.84	0.15	123.40	488.48	5451	51853	-1.08%
62	0.1	23.50	3610.60	0.07	23.00	4.30	290	3115	-2.14%
62	0.5	60.34	3631.30	0.19	59.67	58.88	1698	15221	-1.11%
62	2.0	121.60	4104.80	0.22	120.11	575.86	5598	51269	-1.22%
63	0.1	22.20	3605.80	0.23	22.14	4.46	296	2887	-0.28%
63	0.5	57.04	3620.10	0.18	56.12	50.80	1641	14656	-1.62%
63	2.0	117.14	4364.50	0.17	116.65	531.90	5376	48759	-0.42%
64	0.1	58.46	3978.80	0.16	22.70	4.72	320	2995	-61.18%
64	0.5	117.61	3609.70	0.14	58.46	51.60	1658	14621	-50.29%
64	2.0	118.28	3742.80	0.07	117.61	359.40	5156	47955	-0.56%
65	0.1	59.15	3723.88	0.22	23.47	5.17	379	3243	-60.32%
65	0.5	118.88	3615.09	0.13	58.66	49.77	1639	15170	-50.66%
65	2.0	119.42	3624.47	0.18	118.65	555.70	5510	48947	-0.64%
66	0.1	23.92	3615.68	0.11	23.03	4.43	352	3111	-3.70%
66	0.5	59.55	3625.98	0.13	59.25	58.76	1707	14951	-0.50%
66	2.0	119.68	3735.99	0.20	115.12	583.60	5419	47214	-3.81%
67	0.1	23.60	3614.89	0.19	23.05	5.53	360	3131	-2.30%
67	0.5	120.74	3729.23	0.27	59.56	48.60	1572	15387	-50.67%
67	2.0	119.02	3625.88	0.11	118.14	680.31	5953	50332	-0.75%
68	0.1	22.34	3615.71	0.19	21.20	4.34	294	2831	-5.08%
68	0.5	58.27	3625.73	0.16	57.94	57.53	1590	14789	-0.57%
68	2.0	119.90	3737.52	0.13	118.83	550.29	5355	49721	-0.90%
69	0.1	60.41	3754.21	0.16	22.76	4.25	318	3154	-62.32%
69	0.5	121.70	3616.54	0.18	60.36	56.18	1768	15418	-50.40%

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

Inst	δ	SimExact		SimSA-CVaR					GAP
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
69	2.0	121.94	3629.29	0.32	121.05	606.21	5635	49919	-0.73%
70	0.1	23.82	3615.36	0.18	23.54	5.61	374	3204	-1.19%
70	0.5	59.86	3626.31	0.12	59.65	58.09	1717	15327	-0.36%
70	2.0	124.20	3743.85	0.12	120.28	592.24	5503	49210	-3.16%
71	0.1	58.09	3738.69	0.11	22.75	4.71	351	3028	-60.83%
71	0.5	117.99	3615.08	0.16	58.09	60.56	1710	14856	-50.77%
71	2.0	117.51	3625.73	0.20	116.78	550.98	5352	49231	-0.61%
72	0.1	23.02	3615.15	0.22	22.20	4.51	300	2885	-3.56%
72	0.5	59.26	3624.52	0.08	57.56	50.73	1666	15090	-2.87%
72	2.0	119.15	3732.00	0.09	118.59	551.20	5204	48789	-0.47%
73	0.1	24.43	3614.02	0.09	22.61	4.44	325	2972	-7.44%
73	0.5	60.24	3624.74	0.23	60.17	56.96	1494	15463	-0.12%
73	2.0	122.26	3740.45	0.09	121.32	605.07	5607	49989	-0.77%
74	0.1	23.27	3616.30	0.17	22.43	4.23	334	3101	-3.62%
74	0.5	114.29	3721.12	0.19	55.79	48.62	1547	14347	-51.19%
74	2.0	113.58	3626.57	0.17	112.86	537.76	5329	47072	-0.64%
75	0.1	24.99	3623.43	0.12	23.55	4.87	319	3034	-5.78%
75	0.5	62.41	3633.66	0.11	61.76	62.13	1759	15872	-1.04%
75	2.0	125.36	3783.96	0.10	125.02	652.70	5747	52580	-0.27%
76	0.1	122.61	3622.20	0.22	24.09	5.35	360	3160	-80.36%
76	0.5	61.66	4379.00	0.23	60.70	65.53	1594	15609	-1.56%
76	2.0	123.00	3604.00	0.08	122.61	589.51	5764	50996	-0.31%
77	0.1	23.63	3693.47	0.05	22.73	5.20	342	3036	-3.79%
77	0.5	59.33	3736.54	0.16	59.06	62.64	1710	14867	-0.45%
77	2.0	120.90	4350.05	0.13	120.04	636.14	5706	49985	-0.71%
78	0.1	58.84	4177.40	0.26	21.14	4.95	292	2711	-64.06%
78	0.5	118.85	3611.10	0.18	58.74	52.90	1675	14891	-50.58%
78	2.0	118.38	3742.40	0.36	117.52	616.10	5362	48390	-0.73%
79	0.1	24.66	3692.54	0.13	22.82	5.17	294	2920	-7.47%
79	0.5	58.90	3729.63	0.15	57.91	55.79	1578	14585	-1.68%
79	2.0	121.68	4314.04	0.14	118.39	590.29	5435	50288	-2.71%
80	0.1	24.05	3701.43	0.01	23.01	5.23	372	3102	-4.32%
80	0.5	58.82	3744.79	0.13	58.22	58.81	1520	14628	-1.02%

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

Inst	δ	SimExact		SimSA-CVaR					GAP (1) x (2)
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
80	2.0	116.41	4289.95	0.77	115.49	435.69	5237	47109	-0.79%
81	0.1	23.68	3689.92	0.16	22.83	5.82	338	3007	-3.59%
81	0.5	60.46	3729.32	0.09	59.35	58.65	1636	15079	-1.84%
81	2.0	120.58	4312.90	0.07	118.81	517.69	5391	48479	-1.47%
82	0.1	24.00	3693.98	0.83	23.41	5.53	347	3241	-2.45%
82	0.5	60.38	3732.47	0.84	59.14	59.89	1661	14916	-2.06%
82	2.0	121.00	4339.81	0.72	120.15	601.79	5456	49355	-0.70%
83	0.1	56.85	4284.02	0.63	22.23	13.03	333	3041	-60.91%
83	0.5	116.38	3691.56	0.62	56.85	136.57	1652	14448	-51.15%
83	2.0	117.19	3736.75	0.63	116.38	739.03	5405	48023	-0.69%
84	0.1	58.71	4308.74	0.07	22.97	4.79	323	2928	-60.88%
84	0.5	121.36	3689.87	0.16	58.71	58.98	1676	14842	-51.62%
84	2.0	119.41	3737.38	0.19	118.51	598.40	5451	50285	-0.75%
85	0.1	58.64	3736.23	0.13	22.23	5.02	336	2994	-62.10%
85	0.5	59.21	3688.63	0.27	58.40	60.25	1612	15096	-1.36%
85	2.0	118.18	4302.11	0.30	116.09	533.94	5437	47339	-1.76%
86	0.1	24.29	3605.10	0.13	22.98	5.88	334	3078	-5.38%
86	0.5	62.60	3722.30	0.11	62.48	69.03	1847	15982	-0.20%
86	2.0	129.69	3803.20	0.14	128.06	720.25	5945	53079	-1.26%
87	0.1	119.39	3740.43	0.78	22.35	5.50	340	2913	-81.28%
87	0.5	58.55	4303.91	0.02	58.24	56.34	1514	14639	-0.53%
87	2.0	118.04	3689.67	0.15	117.26	533.68	5799	49324	-0.66%
88	0.1	124.78	3674.20	0.12	23.64	6.01	368	3072	-81.06%
88	0.5	60.70	4234.90	0.15	60.05	61.48	1718	15407	-1.07%
88	2.0	120.64	3609.40	0.20	119.78	692.14	5540	52258	-0.71%
89	0.1	23.60	3685.80	0.02	23.53	4.97	297	3113	-0.32%
89	0.5	59.12	3736.39	0.01	59.08	54.35	1571	15013	-0.07%
89	2.0	118.04	4323.21	0.00	117.18	540.45	5591	48947	-0.73%
90	0.1	120.36	3676.80	0.13	22.16	5.27	311	2855	-81.59%
90	0.5	58.49	3868.80	0.16	57.78	61.82	1702	14711	-1.22%
90	2.0	118.20	3609.30	0.00	117.27	468.85	5832	49248	-0.79%
91	0.1	61.45	4425.62	0.04	22.71	5.49	317	3045	-63.04%
91	0.5	125.64	3693.67	0.10	61.15	67.06	1712	15571	-51.33%

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

Inst	δ	SimExact		SimSA-CVaR					GAP (1) x (2)
		C-RPD (1)	CP	D-RPD	C-RPD (2)	CP	NRSS	NRLS	
91	2.0	126.01	3738.96	0.07	125.64	651.24	5767	52133	-0.29%
92	0.1	60.37	4317.80	0.10	23.42	5.45	360	3014	-61.21%
92	0.5	119.38	3611.00	0.13	59.27	57.65	1668	15382	-50.35%
92	2.0	120.22	3668.60	0.06	119.34	580.96	5316	49174	-0.73%
93	0.1	23.81	3691.62	0.06	22.56	4.92	336	2931	-5.25%
93	0.5	60.45	3738.43	0.15	58.94	59.99	1686	15255	-2.50%
93	2.0	120.31	4351.22	0.11	119.66	571.72	5412	48764	-0.54%
94	0.1	23.68	3608.00	0.03	22.67	4.00	357	2971	-4.29%
94	0.5	59.37	3725.90	0.16	58.69	55.97	1560	15062	-1.15%
94	2.0	123.15	3835.40	0.10	119.63	514.80	5412	49371	-2.86%
95	0.1	25.64	3694.13	0.11	23.81	5.64	328	2982	-7.15%
95	0.5	60.55	3742.27	0.08	58.91	56.69	1593	14894	-2.70%
95	2.0	122.37	4349.52	0.08	120.53	601.43	5378	50306	-1.50%
96	0.1	23.88	3611.20	0.07	23.02	5.28	368	3060	-3.61%
96	0.5	60.96	3646.30	0.12	60.60	59.66	1616	15216	-0.59%
96	2.0	122.46	4244.40	0.13	120.98	522.97	5296	49333	-1.21%
97	0.1	22.73	3615.60	0.06	21.76	4.80	338	3011	-4.28%
97	0.5	120.25	3924.40	0.19	57.88	57.14	1645	14562	-51.87%
97	2.0	117.79	3632.40	0.24	117.08	602.44	5557	49493	-0.61%
98	0.1	25.01	3608.94	0.50	23.89	5.35	313	3168	-4.48%
98	0.5	62.18	3637.80	0.58	61.67	65.60	1810	15952	-0.82%
98	2.0	124.72	4134.42	0.60	123.84	644.86	5769	51788	-0.71%
99	0.1	22.29	3611.90	0.81	22.25	3.69	316	2904	-0.17%
99	0.5	58.94	3653.90	0.18	57.29	57.99	1596	15257	-2.80%
99	2.0	116.99	3821.80	0.15	115.29	479.07	5268	48334	-1.46%
100	0.1	23.67	3615.60	0.11	22.78	5.33	365	3150	-3.73%
100	0.5	59.26	3660.50	0.13	58.14	60.30	1591	14954	-1.89%
100	2.0	117.61	4045.80	0.05	115.14	477.34	5066	47162	-2.10%