

Supplementary results

This document presents supplementary results for the manuscript “Risk-averse formulations and methods for a virtual power plant” by Ricardo M. Lima, Antonio J. Conejo, Sabique Langodan, Ibrahim Hoteit, and Omar M. Knio.

Table S1: Computational results for the extensive form for $\beta = 0.0$ with 5,100 scenarios. Stop criteria: 1500 s, 0.5% gap.

Case	Week	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Gap (%)	Time (s)
1	1	2,998,459	2,998,459	1,196,242	0.00	269
1	2	2,550,776	2,550,776	1,356,204	0.00	270
2	1	348,700	348,700	-297,089	0.00	247
2	2	422,388	422,388	-34,359	0.00	321

ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S2: Computational results for the extensive form for $\beta = 0.0$ with 25,500 scenarios. Stop criteria: 1500 s, 0.5% gap.

Case	Week	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Gap (%)	Time (s)
1	1	3,253,883	3,253,883	1,326,867	0.00	1,747
1	2	*	*	*	*	929
2	1	262,911	262,911	-265,132	1.10	2,317
2	2	*	*	*	*	951

* - Solver aborted during optimization; ObjF - objective function value; Time - elapsed wall-clock time.

Table S3: Performance of the L-Shaped method with single-cuts (SC) and multiple-cuts (MC) for $\beta = 0.0$ with 5,100 scenarios. Stop criteria: 1500 s, 0.5% gap.

Case	Week	Cuts	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
1	1	SC	2,998,459	2,998,459	1,196,242	2	0.00	42
1	1	MC	2,998,459	2,998,459	1,196,242	2	0.00	43
1	2	SC	2,550,776	2,550,776	1,356,204	2	0.04	43
1	2	MC	2,550,776	2,550,776	1,356,204	2	0.04	44
2	1	SC	348,700	348,700	-297,089	3	0.35	71
2	1	MC	348,700	348,700	-297,089	3	0.35	91
2	2	SC	410,788	410,788	-33,090	21	5.36	1,570
2	2	MC	408,867	408,867	-34,594	7	5.77	2,431

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S4: Performance of the L-Shaped method with single-cuts (SC) and multiple-cuts (MC) for $\beta = 0.0$ with 25,500 scenarios. Stop criteria: 1500 s, 0.5% gap.

Case	Week	Cuts	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
1	1	SC	3,253,883	3,253,883	1,326,867	2	0.00	702
1	1	MC	3,253,883	3,253,883	1,326,867	2	0.00	708
1	2	SC	2,717,178	2,717,178	1,505,211	2	0.03	700
1	2	MC	2,717,178	2,717,178	1,505,211	2	0.03	747
2	1	SC	441,482	441,482	-253,701	3	0.28	1,346
2	1	MC	441,482	441,482	-253,701	3	0.28	1,430
2	2	SC	465,801	465,801	18,916	4	6.31	2,002
2	2	MC	466,446	466,446	18,790	3	6.20	1,524

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S5: Case 1, Week 1, with the first risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	2,845,483	2,980,957	1,626,223	2	0.00	55
ALG 1 SC/SC	0.50	2,382,473	2,828,992	1,935,954	2	0.00	54
ALG 1 SC/SC	0.90	2,121,649	2,510,288	2,078,467	2	0.00	54
ALG 1 SC/MC	0.10	2,845,483	2,980,957	1,626,223	2	0.00	54
ALG 1 SC/MC	0.50	2,382,473	2,828,992	1,935,954	2	0.00	54
ALG 1 SC/MC	0.90	2,121,649	2,510,288	2,078,467	2	0.00	55
ALG 1 MC/SC	0.10	2,845,483	2,980,957	1,626,223	2	0.00	55
ALG 1 MC/SC	0.50	2,382,473	2,828,992	1,935,954	2	0.00	56
ALG 1 MC/SC	0.90	2,121,649	2,510,288	2,078,467	2	0.00	56
ALG 1 MC/MC	0.10	2,845,483	2,980,957	1,626,223	2	0.00	55
ALG 1 MC/MC	0.50	2,382,473	2,828,992	1,935,954	2	0.00	56
ALG 1 MC/MC	0.90	2,121,649	2,510,288	2,078,467	2	0.00	55
ALG 2 SC/SC	0.10	2,845,483	2,980,957	1,626,223	6	0.12	202
ALG 2 SC/SC	0.50	2,382,473	2,828,992	1,935,954	7	0.18	254
ALG 2 SC/SC	0.90	2,121,649	2,510,288	2,078,467	7	0.18	255
ALG 2 SC/MC	0.10	2,845,483	2,980,957	1,626,223	3	0.00	83
ALG 2 SC/MC	0.50	2,382,473	2,828,992	1,935,954	3	0.00	83
ALG 2 SC/MC	0.90	2,121,649	2,510,288	2,078,467	3	0.00	83
ALG 2 MC/SC	0.10	2,845,483	2,980,957	1,626,223	6	0.12	221
ALG 2 MC/SC	0.50	2,382,473	2,828,992	1,935,954	7	0.18	279
ALG 2 MC/SC	0.90	2,121,649	2,510,288	2,078,467	7	0.18	279
ALG 2 MC/MC	0.10	2,845,483	2,980,957	1,626,223	3	0.00	88
ALG 2 MC/MC	0.50	2,382,473	2,828,992	1,935,954	3	0.00	87
ALG 2 MC/MC	0.90	2,121,649	2,510,288	2,078,467	3	0.00	87

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S6: Case 1, Week 2, with the first risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	2,431,319	2,550,776	1,356,204	2	0.04	54
ALG 1 SC/SC	0.50	2,060,778	2,516,110	1,605,447	2	0.07	54
ALG 1 SC/SC	0.90	1,797,982	2,354,142	1,736,186	2	0.11	53
ALG 1 SC/MC	0.10	2,431,319	2,550,776	1,356,204	2	0.04	54
ALG 1 SC/MC	0.50	2,060,778	2,516,110	1,605,447	2	0.07	54
ALG 1 SC/MC	0.90	1,797,982	2,354,142	1,736,186	2	0.11	54
ALG 1 MC/SC	0.10	2,431,319	2,550,776	1,356,204	2	0.04	55
ALG 1 MC/SC	0.50	2,060,778	2,516,110	1,605,447	2	0.07	54
ALG 1 MC/SC	0.90	1,797,982	2,354,142	1,736,186	2	0.11	55
ALG 1 MC/MC	0.10	2,431,319	2,550,776	1,356,204	2	0.04	54
ALG 1 MC/MC	0.50	2,060,778	2,516,110	1,605,447	2	0.07	54
ALG 1 MC/MC	0.90	1,797,982	2,354,142	1,736,186	2	0.11	55
ALG 2 SC/SC	0.10	2,431,319	2,550,776	1,356,204	6	0.03	202
ALG 2 SC/SC	0.50	2,060,778	2,516,110	1,605,447	6	0.18	202
ALG 2 SC/SC	0.90	1,797,982	2,354,142	1,736,186	6	0.30	203
ALG 2 SC/MC	0.10	2,431,319	2,550,776	1,356,204	3	0.00	84
ALG 2 SC/MC	0.50	2,060,778	2,516,110	1,605,447	3	0.00	84
ALG 2 SC/MC	0.90	1,797,982	2,354,142	1,736,186	3	0.00	84
ALG 2 MC/SC	0.10	2,431,319	2,550,776	1,356,204	6	0.03	253
ALG 2 MC/SC	0.50	2,060,778	2,516,110	1,605,447	6	0.18	252
ALG 2 MC/SC	0.90	1,797,982	2,354,142	1,736,186	6	0.30	252
ALG 2 MC/MC	0.10	2,431,319	2,550,776	1,356,204	3	0.00	95
ALG 2 MC/MC	0.50	2,060,778	2,516,110	1,605,447	3	0.00	95
ALG 2 MC/MC	0.90	1,797,982	2,354,142	1,736,186	3	0.00	95

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S7: Case 1, Week 1, with the first risk-averse formulation and 25,500 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	3,061,181	3,253,883	1,326,867	2	0.00	777
ALG 1 SC/SC	0.50	2,477,291	2,956,407	1,998,176	2	0.01	777
ALG 1 SC/SC	0.90	2,160,014	2,731,808	2,096,481	2	0.01	746
ALG 1 SC/MC	0.10	3,061,181	3,253,883	1,326,867	2	0.00	748
ALG 1 SC/MC	0.50	2,477,291	2,956,407	1,998,176	2	0.01	781
ALG 1 SC/MC	0.90	2,160,014	2,731,808	2,096,481	2	0.01	770
ALG 1 MC/SC	0.10	3,061,181	3,253,883	1,326,867	2	0.00	782
ALG 1 MC/SC	0.50	2,477,291	2,956,407	1,998,176	2	0.01	749
ALG 1 MC/SC	0.90	2,160,014	2,731,808	2,096,481	2	0.01	787
ALG 1 MC/MC	0.10	3,061,181	3,253,883	1,326,867	2	0.00	783
ALG 1 MC/MC	0.50	2,477,291	2,956,407	1,998,176	2	0.01	783
ALG 1 MC/MC	0.90	2,160,014	2,731,808	2,096,481	2	0.01	785
ALG 2 SC/SC	0.10	3,061,181	3,253,883	1,326,867	4	3.09	1,683
ALG 2 SC/SC	0.50	2,448,239	3,173,392	1,723,086	4	14.52	1,687
ALG 2 SC/SC	0.90	2,093,999	2,956,407	1,998,176	4	20.14	1,684
ALG 2 SC/MC	0.10	3,061,181	3,253,883	1,326,867	3	0.00	1,156
ALG 2 SC/MC	0.50	2,477,291	2,956,407	1,998,176	3	0.00	1,171
ALG 2 SC/MC	0.90	2,160,014	2,731,808	2,096,481	3	0.00	1,178
ALG 2 MC/SC	0.10	3,061,181	3,253,883	1,326,867	4	3.09	1,731
ALG 2 MC/SC	0.50	2,448,239	3,173,392	1,723,086	4	14.52	1,723
ALG 2 MC/SC	0.90	2,093,999	2,956,407	1,998,176	4	20.14	1,718
ALG 2 MC/MC	0.10	3,061,181	3,253,883	1,326,867	3	0.00	1,203
ALG 2 MC/MC	0.50	2,477,291	2,956,407	1,998,176	3	0.00	1,203
ALG 2 MC/MC	0.90	2,160,014	2,731,808	2,096,481	3	0.00	1,199

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S8: Case 1, Week 2, with the first risk-averse formulation and 25,500 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	2,595,981	2,717,178	1,505,211	2	0.04	780
ALG 1 SC/SC	0.50	2,180,535	2,642,537	1,718,533	2	0.07	768
ALG 1 SC/SC	0.90	1,874,710	2,439,304	1,811,977	2	0.11	809
ALG 1 SC/MC	0.10	2,595,981	2,717,178	1,505,211	2	0.04	812
ALG 1 SC/MC	0.50	2,180,535	2,642,537	1,718,533	2	0.07	811
ALG 1 SC/MC	0.90	1,874,710	2,439,304	1,811,977	2	0.11	819
ALG 1 MC/SC	0.10	2,595,981	2,717,178	1,505,211	2	0.04	813
ALG 1 MC/SC	0.50	2,180,535	2,642,537	1,718,533	2	0.07	813
ALG 1 MC/SC	0.90	1,874,710	2,439,304	1,811,977	2	0.11	782
ALG 1 MC/MC	0.10	2,595,981	2,717,178	1,505,211	2	0.04	810
ALG 1 MC/MC	0.50	2,180,535	2,642,537	1,718,533	2	0.07	804
ALG 1 MC/MC	0.90	1,874,710	2,439,304	1,811,977	2	0.11	820
ALG 2 SC/SC	0.10	2,595,981	2,717,178	1,505,211	4	2.36	1,813
ALG 2 SC/SC	0.50	2,111,195	2,717,178	1,505,211	4	14.54	1,791
ALG 2 SC/SC	0.90	1,810,933	2,642,537	1,718,533	4	23.26	1,798
ALG 2 SC/MC	0.10	2,595,981	2,717,178	1,505,211	3	0.00	1,260
ALG 2 SC/MC	0.50	2,180,535	2,642,537	1,718,533	3	0.00	1,225
ALG 2 SC/MC	0.90	1,874,710	2,439,304	1,811,977	3	0.00	1,255
ALG 2 MC/SC	0.10	2,595,981	2,717,178	1,505,211	4	2.36	1,881
ALG 2 MC/SC	0.50	2,111,195	2,717,178	1,505,211	4	14.54	1,866
ALG 2 MC/SC	0.90	1,810,933	2,642,537	1,718,533	4	23.26	1,889
ALG 2 MC/MC	0.10	2,595,981	2,717,178	1,505,211	3	0.00	1,277
ALG 2 MC/MC	0.50	2,180,535	2,642,537	1,718,533	3	0.00	1,310
ALG 2 MC/MC	0.90	1,874,710	2,439,304	1,811,977	3	0.00	1,305

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S9: Case 2, Week 1, with the first risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	311,193	331,197	131,153	3	0.40	104
ALG 1 SC/SC	0.50	257,507	277,540	237,474	4	0.47	171
ALG 1 SC/SC	0.90	244,000	272,319	240,854	4	0.50	176
ALG 1 SC/MC	0.10	311,193	331,197	131,153	3	0.40	112
ALG 1 SC/MC	0.50	257,507	277,540	237,474	4	0.47	198
ALG 1 SC/MC	0.90	244,000	272,319	240,854	4	0.50	198
ALG 1 MC/SC	0.10	311,193	331,197	131,153	3	0.39	117
ALG 1 MC/SC	0.50	257,507	277,540	237,474	3	0.49	133
ALG 1 MC/SC	0.90	244,000	272,319	240,854	4	0.50	250
ALG 1 MC/MC	0.10	311,193	331,197	131,153	3	0.39	141
ALG 1 MC/MC	0.50	257,507	277,540	237,474	3	0.49	159
ALG 1 MC/MC	0.90	244,000	272,319	240,854	4	0.50	374
ALG 2 SC/SC	0.10	311,193	331,197	131,153	7	0.20	262
ALG 2 SC/SC	0.50	256,493	272,110	240,876	19	2.40	1,556
ALG 2 SC/SC	0.90	240,328	268,455	237,203	18	9.35	1,534
ALG 2 SC/MC	0.10	311,193	331,197	131,153	7	0.00	316
ALG 2 SC/MC	0.50	257,509	277,312	237,706	7	0.00	329
ALG 2 SC/MC	0.90	244,001	272,258	240,861	7	0.00	333
ALG 2 MC/SC	0.10	311,193	331,197	131,153	7	0.20	441
ALG 2 MC/SC	0.50	257,502	276,718	238,286	12	1.76	1,649
ALG 2 MC/SC	0.90	240,328	268,455	237,203	12	11.23	1,601
ALG 2 MC/MC	0.10	311,193	331,197	131,153	7	0.00	537
ALG 2 MC/MC	0.50	257,509	277,312	237,706	7	0.00	693
ALG 2 MC/MC	0.90	244,001	272,258	240,861	7	0.00	580

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S10: Case 2, Week 2, with the first risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	361,488	405,219	-32,092	8	7.41	2,270
ALG 1 SC/SC	0.50	289,863	368,118	211,607	8	8.08	3,018
ALG 1 SC/SC	0.90	245,088	307,035	238,205	7	10.56	1,874
ALG 1 SC/MC	0.10	361,488	405,219	-32,092	8	7.41	1,549
ALG 1 SC/MC	0.50	289,863	368,118	211,607	8	8.04	2,103
ALG 1 SC/MC	0.90	245,088	307,035	238,205	8	10.36	2,216
ALG 1 MC/SC	0.10	361,115	404,813	-32,170	6	7.55	2,157
ALG 1 MC/SC	0.50	288,764	366,367	211,161	6	8.80	2,261
ALG 1 MC/SC	0.90	245,088	307,035	238,205	6	10.67	2,294
ALG 1 MC/MC	0.10	361,115	404,813	-32,170	6	7.42	1,787
ALG 1 MC/MC	0.50	288,764	366,367	211,161	7	8.57	2,970
ALG 1 MC/MC	0.90	245,088	307,035	238,205	6	10.65	1,662
ALG 2 SC/SC	0.10	366,608	410,912	-32,127	20	5.83	1,614
ALG 2 SC/SC	0.50	285,672	366,471	204,874	18	25.52	1,534
ALG 2 SC/SC	0.90	199,963	322,079	186,395	16	98.91	1,730
ALG 2 SC/MC	0.10	364,799	408,787	-31,093	12	6.25	1,563
ALG 2 SC/MC	0.50	289,027	370,849	207,204	10	8.48	1,591
ALG 2 SC/MC	0.90	227,395	288,290	220,629	8	25.32	1,918
ALG 2 MC/SC	0.10	362,158	406,269	-34,846	9	7.13	1,600
ALG 2 MC/SC	0.50	286,742	368,844	204,639	8	31.67	1,501
ALG 2 MC/SC	0.90	188,321	302,474	175,638	8	113.15	2,429
ALG 2 MC/MC	0.10	365,374	409,561	-32,315	7	6.07	1,718
ALG 2 MC/MC	0.50	289,027	370,849	207,204	7	9.62	2,261
ALG 2 MC/MC	0.90	230,203	292,692	223,260	6	24.63	1,973

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S11: Case 2, Week 1, with the first risk-averse formulation and 25,500 scenarios. Comparison of the performance of the algorithms.

Algorithm	β	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC/SC	0.10	371,963	441,482	-253,701	3	0.34	1,547
ALG 1 SC/SC	0.50	260,440	295,938	224,942	3	0.51	1,577
ALG 1 SC/SC	0.90	242,985	273,641	239,579	3	0.52	1,613
ALG 1 SC/MC	0.10	371,963	441,482	-253,701	3	0.34	1,461
ALG 1 SC/MC	0.50	260,440	295,938	224,942	3	0.51	1,869
ALG 1 SC/MC	0.90	445,828	445,828	445,828	4	45.22	2,118
ALG 1 MC/SC	0.10	371,963	441,482	-253,701	3	0.33	1,511
ALG 1 MC/SC	0.50	260,440	295,938	224,942	3	0.49	1,825
ALG 1 MC/SC	0.90	445,828	445,828	445,828	3	45.22	1,535
ALG 1 MC/MC	0.10	371,963	441,482	-253,701	3	0.33	1,818
ALG 1 MC/MC	0.50	313,660	313,660	313,660	3	16.56	1,757
ALG 1 MC/MC	0.90	445,828	445,828	445,828	3	45.22	1,928
ALG 2 SC/SC	0.10	368,225	437,674	-256,816	4	10.88	2,004
ALG 2 SC/SC	0.50	243,659	352,168	135,150	4	23.33	1,988
ALG 2 SC/SC	0.90	234,032	266,608	230,413	4	16.27	2,029
ALG 2 SC/MC	0.10	368,225	437,674	-256,816	4	1.35	2,110
ALG 2 SC/MC	0.50	257,635	292,869	222,401	4	1.55	2,070
ALG 2 SC/MC	0.90	240,223	274,648	236,398	4	1.66	2,159
ALG 2 MC/SC	0.10	367,810	437,260	-257,241	3	19.17	1,596
ALG 2 MC/SC	0.50	90,429	437,674	-256,816	3	365.82	1,527
ALG 2 MC/SC	0.90	234,032	266,608	230,413	4	16.27	2,186
ALG 2 MC/MC	0.10	368,225	437,674	-256,816	3	1.35	1,735
ALG 2 MC/MC	0.50	257,009	292,130	221,889	3	1.88	1,527
ALG 2 MC/MC	0.90	239,509	269,973	236,124	3	2.11	1,529

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S12: Case 1, Week 1, with the second risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	2,798,057	2,980,957	2,798,057	2	0.00	63
ALG 1 SC	0.50	2,391,273	2,828,992	2,391,273	2	0.00	58
ALG 1 SC	0.90	2,078,467	2,510,288	2,078,467	2	0.00	51
ALG 1 SC	0.95	2,020,182	2,510,288	2,020,182	2	0.00	50
ALG 1 SC	1.00	1,954,807	2,510,288	1,954,807	2	0.02	50
ALG 1 MC	0.10	2,798,057	2,980,957	2,798,057	2	0.00	63
ALG 1 MC	0.50	2,391,273	2,828,992	2,391,273	2	0.00	57
ALG 1 MC	0.90	2,078,467	2,510,288	2,078,467	2	0.00	51
ALG 1 MC	0.95	2,020,182	2,510,288	2,020,182	2	0.00	51
ALG 1 MC	1.00	1,954,807	2,510,288	1,954,807	2	0.02	50
ALG 2 SC	0.10	2,798,057	2,980,957	2,798,057	6	0.07	212
ALG 2 SC	0.50	2,391,273	2,828,992	2,391,273	6	0.09	187
ALG 2 SC	0.90	2,078,467	2,510,288	2,078,467	7	0.20	198
ALG 2 SC	0.95	2,020,182	2,510,288	2,020,182	7	0.42	195
ALG 2 SC	1.00	1,954,807	2,510,288	1,954,807	10	0.33	304
ALG 2 MC	0.10	2,798,057	2,980,957	2,798,057	3	0.00	103
ALG 2 MC	0.50	2,391,273	2,828,992	2,391,273	3	0.00	89
ALG 2 MC	0.90	2,078,467	2,510,288	2,078,467	3	0.00	76
ALG 2 MC	0.95	2,020,182	2,510,288	2,020,182	3	0.00	75
ALG 2 MC	1.00	1,954,807	2,510,288	1,954,807	3	0.02	72

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S13: Case 1, Week 2, with the second risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	2,408,220	2,529,094	2,408,220	2	0.04	62
ALG 1 SC	0.50	2,104,723	2,516,110	2,104,723	2	0.07	57
ALG 1 SC	0.90	1,740,441	2,257,999	1,740,441	2	0.12	52
ALG 1 SC	0.95	1,694,414	2,163,158	1,694,414	2	0.17	51
ALG 1 SC	1.00	1,610,324	2,163,158	1,610,324	2	0.34	50
ALG 1 MC	0.10	2,408,220	2,529,094	2,408,220	2	0.04	63
ALG 1 MC	0.50	2,104,723	2,516,110	2,104,723	2	0.07	58
ALG 1 MC	0.90	1,740,441	2,257,999	1,740,441	2	0.12	51
ALG 1 MC	0.95	1,694,414	2,163,158	1,694,414	2	0.17	50
ALG 1 MC	1.00	1,610,324	2,163,158	1,610,324	2	0.34	50
ALG 2 SC	0.10	2,408,050	2,550,776	2,408,050	6	0.12	213
ALG 2 SC	0.50	2,104,723	2,516,110	2,104,723	6	0.18	184
ALG 2 SC	0.90	1,740,441	2,257,999	1,740,441	6	0.29	160
ALG 2 SC	0.95	1,694,414	2,163,158	1,694,414	7	0.12	194
ALG 2 SC	1.00	1,610,324	2,163,158	1,610,324	16	0.37	584
ALG 2 MC	0.10	2,408,220	2,529,094	2,408,220	3	0.00	109
ALG 2 MC	0.50	2,104,723	2,516,110	2,104,723	3	0.00	94
ALG 2 MC	0.90	1,740,441	2,257,999	1,740,441	3	0.00	77
ALG 2 MC	0.95	1,694,414	2,163,158	1,694,414	3	0.00	75
ALG 2 MC	1.00	1,610,324	2,163,158	1,610,324	3	0.18	74

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S14: Case 1, Week 1, with the second risk-averse formulation and 25,500 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	2,975,997	3,253,883	2,975,997	2	0.00	1,075
ALG 1 SC	0.50	2,449,115	2,956,407	2,449,115	2	0.00	926
ALG 1 SC	0.90	2,106,458	2,572,681	2,106,458	2	0.01	769
ALG 1 SC	0.95	2,055,090	2,572,681	2,055,090	2	0.02	712
ALG 1 SC	1.00	1,928,096	2,572,681	1,928,096	2	0.01	720
ALG 1 MC	0.10	2,975,997	3,253,883	2,975,997	2	0.00	1,077
ALG 1 MC	0.50	2,449,115	2,956,407	2,449,115	2	0.00	925
ALG 1 MC	0.90	2,106,458	2,572,681	2,106,458	2	0.01	775
ALG 1 MC	0.95	2,055,090	2,572,681	2,055,090	2	0.02	733
ALG 1 MC	1.00	1,928,096	2,572,681	1,928,096	2	0.01	714
ALG 2 SC	0.10	2,944,596	3,246,690	2,944,596	3	18.15	1,559
ALG 2 SC	0.50	2,449,115	2,956,407	2,449,115	4	2.43	1,924
ALG 2 SC	0.90	1,998,176	2,956,407	1,998,176	4	23.45	1,601
ALG 2 SC	0.95	1,887,524	2,956,407	1,887,524	4	31.39	1,528
ALG 2 SC	1.00	1,634,088	2,956,407	1,634,088	4	53.21	1,528
ALG 2 MC	0.10	2,975,997	3,253,883	2,975,997	3	0.00	1,655
ALG 2 MC	0.50	2,449,115	2,956,407	2,449,115	3	0.00	1,419
ALG 2 MC	0.90	2,106,458	2,572,681	2,106,458	3	0.00	1,140
ALG 2 MC	0.95	2,055,090	2,572,681	2,055,090	3	0.00	1,075
ALG 2 MC	1.00	1,928,096	2,572,681	1,928,096	3	0.01	1,031

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S15: Case 1, Week 2, with the second risk-averse formulation and 25,500 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	2,560,805	2,717,178	2,560,805	2	0.03	1,141
ALG 1 SC	0.50	2,184,950	2,642,537	2,184,950	2	0.05	962
ALG 1 SC	0.90	1,811,977	2,439,304	1,811,977	2	0.12	794
ALG 1 SC	0.95	1,720,683	2,328,976	1,720,683	2	0.16	781
ALG 1 SC	1.00	1,898,844	1,898,844	1,898,844	4	19.99	2,569
ALG 1 MC	0.10	2,560,805	2,717,178	2,560,805	2	0.03	1,134
ALG 1 MC	0.50	2,184,950	2,642,537	2,184,950	2	0.05	935
ALG 1 MC	0.90	1,811,977	2,439,304	1,811,977	2	0.12	803
ALG 1 MC	0.95	1,720,683	2,328,976	1,720,683	2	0.16	775
ALG 1 MC	1.00	1,898,844	1,898,844	1,898,844	4	19.99	2,349
ALG 2 SC	0.10	2,560,805	2,717,178	2,560,805	3	11.24	1,632
ALG 2 SC	0.50	2,184,950	2,642,537	2,184,950	4	2.69	2,023
ALG 2 SC	0.90	1,718,533	2,642,537	1,718,533	4	27.23	1,730
ALG 2 SC	0.95	1,570,651	2,642,537	1,570,651	4	40.03	1,693
ALG 2 SC	1.00	1,062,162	2,642,537	1,062,162	4	108.28	1,613
ALG 2 MC	0.10	2,560,805	2,717,178	2,560,805	3	0.00	1,742
ALG 2 MC	0.50	2,184,950	2,642,537	2,184,950	3	0.00	1,476
ALG 2 MC	0.90	1,811,977	2,439,304	1,811,977	3	0.00	1,220
ALG 2 MC	0.95	1,720,683	2,328,976	1,720,683	3	0.00	1,157
ALG 2 MC	1.00	1,472,693	1,884,410	1,472,693	4	2.66	1,780

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S16: Case 2, Week 1, with the second risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	301,707	331,197	301,707	3	0.40	115
ALG 1 SC	0.50	255,397	275,912	255,397	3	0.48	109
ALG 1 SC	0.90	240,895	271,655	240,895	5	0.25	227
ALG 1 SC	0.95	237,129	271,458	237,129	5	0.26	219
ALG 1 SC	1.00	224,171	274,471	224,171	11	0.64	1,957
ALG 1 MC	0.10	301,707	331,197	301,707	3	0.40	130
ALG 1 MC	0.50	255,397	275,912	255,397	3	0.48	124
ALG 1 MC	0.90	240,895	271,655	240,895	5	0.25	293
ALG 1 MC	0.95	237,129	271,458	237,129	5	0.26	265
ALG 1 MC	1.00	224,171	274,471	224,171	12	0.49	1,642
ALG 2 SC	0.10	301,707	331,197	301,707	12	0.17	608
ALG 2 SC	0.50	254,819	274,259	254,819	23	1.20	1,609
ALG 2 SC	0.90	237,556	273,295	237,556	23	10.88	1,539
ALG 2 SC	0.95	235,669	273,598	235,669	24	7.26	1,607
ALG 2 SC	1.00	216,160	272,394	216,160	23	20.91	1,528
ALG 2 MC	0.10	301,707	331,197	301,707	7	0.00	572
ALG 2 MC	0.50	255,397	275,801	255,397	7	0.00	382
ALG 2 MC	0.90	240,896	271,600	240,896	7	0.00	275
ALG 2 MC	0.95	237,130	271,375	237,130	7	0.00	248
ALG 2 MC	1.00	221,834	273,254	221,834	26	1.34	1,514

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S17: Case 2, Week 2, with the second risk-averse formulation and 5,100 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	354,443	406,891	354,443	7	6.90	2,194
ALG 1 SC	0.50	292,348	368,608	292,348	7	8.32	1,764
ALG 1 SC	0.90	237,262	304,388	237,262	7	10.77	2,419
ALG 1 SC	0.95	229,099	302,395	229,099	7	11.12	1,785
ALG 1 SC	1.00	195,184	292,115	195,184	8	18.23	2,537
ALG 1 MC	0.10	354,443	406,891	354,443	8	6.83	2,108
ALG 1 MC	0.50	292,911	369,312	292,911	8	7.95	2,842
ALG 1 MC	0.90	238,178	305,817	238,178	8	10.21	2,294
ALG 1 MC	0.95	229,099	302,395	229,099	8	10.94	2,216
ALG 1 MC	1.00	195,184	292,115	195,184	9	18.16	2,677
ALG 2 SC	0.10	351,819	404,022	351,819	20	19.67	1,595
ALG 2 SC	0.50	273,980	347,653	273,980	21	42.36	1,631
ALG 2 SC	0.90	181,110	314,251	181,110	16	120.89	2,057
ALG 2 SC	0.95	168,731	323,555	168,731	18	134.82	1,724
ALG 2 SC	1.00	124,154	327,303	124,154	16	227.45	1,609
ALG 2 MC	0.10	354,086	406,650	354,086	8	6.89	2,701
ALG 2 MC	0.50	281,450	357,206	281,450	8	17.84	2,453
ALG 2 MC	0.90	221,385	287,966	221,385	8	26.23	2,109
ALG 2 MC	0.95	211,845	286,497	211,845	8	26.50	1,640
ALG 2 MC	1.00	157,180	270,817	157,180	8	58.62	2,019

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.

Table S18: Case 2, Week 1, with the second risk-averse formulation and 25,500 scenarios. Comparison of the performance of the algorithms.

Algorithm	α	ObjF (\$)	E[Profit] (\$)	CVaR[Profit] (\$)	Iter	Gap (%)	Time (s)
ALG 1 SC	0.10	339,683	441,482	339,683	3	0.36	2,036
ALG 1 SC	0.50	255,593	284,973	255,593	3	0.49	1,910
ALG 1 SC	0.90	239,628	272,704	239,628	3	0.51	1,593
ALG 1 SC	0.95	236,004	272,392	236,004	4	0.52	2,219
ALG 1 SC	1.00	219,584	270,280	219,584	4	1.45	2,151
ALG 1 MC	0.10	339,683	441,482	339,683	3	0.36	2,066
ALG 1 MC	0.50	379,514	379,514	379,514	3	32.32	1,708
ALG 1 MC	0.90	239,628	272,704	239,628	3	0.51	1,805
ALG 1 MC	0.95	236,004	272,392	236,004	3	0.52	1,808
ALG 1 MC	1.00	210,745	264,717	210,745	3	5.72	1,526
ALG 2 SC	0.10	308,288	434,288	308,288	3	72.81	1,760
ALG 2 SC	0.50	237,682	357,182	237,682	3	25.31	1,539
ALG 2 SC	0.90	229,381	272,706	229,381	4	20.85	1,947
ALG 2 SC	0.95	226,807	266,040	226,807	4	20.02	1,925
ALG 2 SC	1.00	210,300	269,757	210,300	4	29.70	1,872
ALG 2 MC	0.10	335,544	437,260	335,544	3	1.60	2,013
ALG 2 MC	0.50	252,070	281,304	252,070	3	2.00	1,760
ALG 2 MC	0.90	236,115	268,924	236,115	4	2.00	2,065
ALG 2 MC	0.95	232,496	268,685	232,496	4	2.03	1,991
ALG 2 MC	1.00	213,400	272,032	213,400	4	4.01	1,941

Iter - Number of iterations; ObjF - Objective function value; Time - Elapsed wall-clock time.