Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
bt10-1	0.0001	1	9	2	9.48E-08	2.22E-04
bt10-2	0.0001	1	9	2	9.53E-08	1.99E-04
bt10-3	0.0001	1	9	2	9.52E-08	1.99E-04
bt10-4	0.0001	1	9	2	9.52E-08	2.00E-04
bt10-5	0.0001	1	9	2	9.60E-08	2.46E-04
bt10-ave	0.0001	1.0	9.0	2.0	9.53E-08	2.13E-04
bt10-1	0.001	1	9	2	9.06E-08	1.01E-03
bt10-2	0.001	1	9	2	9.59E-08	2.35E-04
bt10-3	0.001	1	9	2	9.46E-08	2.65E-04
bt10-4	0.001	1	9	2	9.43E-08	3.01E-04
bt10-5	0.001	1	9	2	1.02E-07	1.47E-03
bt10-ave	0.001	1.0	9.0	2.0	9.54E-08	6.57E-04
bt10-1	0.01	1	9	3	7.31E-08	9.96E-03
bt10-2	0.01	1	9	2	1.01E-07	1.26E-03
bt10-3	0.01	1	9	2	8.77E-08	1.77E-03
bt10-4	0.01	1	9	3	7.40E-08	2.28E-03
bt10-5	0.01	1	9	3	7.48E-08	1.46E-02
bt10-ave	0.01	1.0	9.0	2.6	8.21E-08	5.97E-03
byrdsphr-1	0.0001	1	61	1	2.19E-05	5.42E-03
byrdsphr-2	0.0001	1	53	1	3.88E-06	2.28E-03
byrdsphr-3	0.0001	1	51	1	7.86E-06	3.25E-03
byrdsphr-4	0.0001	1	51	1	5.58E-09	8.74E-05
byrdsphr-5	0.0001	1	59	1	1.06E-05	3.77E-03
byrdsphr-ave	0.0001	1.0	55.0	1.0	8.85E-06	2.96E-03
byrdsphr-1	0.001	1	53	2	2.30E-04	1.76E-02
byrdsphr-2	0.001	1	44	2	4.06E-05	7.38E-03
byrdsphr-3	0.001	1	94	2	8.23E-05	1.05E-02
byrdsphr-4	0.001	1	273	2	5.16E-09	1.57E-04
byrdsphr-5	0.001	1	67	2	1.11E-04	1.22E-02
byrdsphr-ave	0.001	1.0	106.2	2.0	9.27E-05	9.56E-03
byrdsphr-1	0.01	1	41	3	2.31E-03	5.57E-02
byrdsphr-2	0.01	1	56	2	4.06E-04	2.33E-02
byrdsphr-3	0.01	1	314	3	8.23E-04	3.32E-02
byrdsphr-4	0.01	1	48	3	5.18E-09	1.34E-03
byrdsphr-5	0.01	1	56	3	1.11E-03	3.86E-02
byrdsphr-ave	0.01	1.0	103.0	2.8	9.30E-04	3.04E-02
cantilvr-1	0.0001	1	15	5	4.98E-06	5.13E-03
cantilvr-2	0.0001	1	15	5	1.45E-06	2.77E-03
cantilvr-3	0.0001	1	15	5	3.91E-06	4.55E-03
cantilvr-4	0.0001	1	15	5	4.92E-06	5.10E-03
cantilvr-5	0.0001	1	15	5	8.48E-07	2.12E-03
cantilvr-ave	0.0001	1.0	15.0	5.0	3.22E-06	3.94E-03
cantilvr-1	0.001	1	15	5	4.99E-05	1.62E-02
cantilvr-2	0.001	1	15	5	1.46E-05	8.78E-03
cantilvr-3	0.001	1	15	5	3.91E-05	1.44E-02
cantilvr-4	0.001	1	15	5	4.91E-05	1.61E-02
cantilvr-5	0.001	1	15	5	8.50E-06	6.71E-03
cantilvr-ave	0.001	1.0	15.0	5.0	3.22E-05	1.24E-02
cantilvr-1	0.01	1	15	5	5.00E-04	5.15E-02
cantilvr-2	0.01	1	15	5	1.46E-04	2.78E-02
cantilvr-3	0.01	1	15	5	3.90E-04	4.54E-02
cantilvr-4	0.01	1	15	5	4.92E-04	5.10E-02
cantilvr-5	0.01	1	15	5	8.50E-05	2.12E-02
cantilvr-ave	0.01	1.0	15.0	5.0	3.23E-04	3.94E-02

TABLE 1. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
cb2-1	0.0001	1	14	4	3.44E-06	2.00E-03
cb2-2	0.0001	1	14	4	1.05E-08	1.11E-04
cb2-3	0.0001	1	14	4	1.05E-08	1.11E-04
cb2-4	0.0001	1	14	4	9.93E-07	1.08E-03
cb2-5	0.0001	1	14	4	2.31E-06	1.64E-03
cb2-ave	0.0001	1.0	14.0	4.0	1.35E-06	9.89E-04
cb2-1	0.001	1	14	4	3.43E-05	6.33E-03
cb2-2	0.001	1	14	4	1.05E-08	1.20E-04
cb2-3	0.001	1	14	4	1.05E-08	1.45E-04
cb2-4	0.001	1	13	4	9.86E-06	3.40E-03
cb2-5	0.001	1	13	4	2.30E-05	5.19E-03
cb2-ave	0.001	1.0	13.6	4.0	1.34E-05	3.04E-03
cb2-1	0.01	1	13	4	3.43E-04	2.00E-02
cb2-2	0.01	1	13	4	1.05E-08	4.72E-04
cb2-3	0.01	1	12	4	1.05E-08	9.35E-04
cb2-4	0.01	1	11	4	9.86E-05	1.07E-02
cb2-5	0.01	1	10	4	2.30E-04	1.64E-02
cb2-ave	0.01	1.0	11.8	4.0	1.34E-04	9.71E-03
cb3-1	0.0001	1	11	5	6.73E-09	9.48E-05
cb3-2	0.0001	1	11	5	6.73E-09	9.39E-05
cb3-3	0.0001	1	11	5	6.73E-09	9.42E-05
cb3-4	0.0001	1	11	5	6.73E-09	9.39E-05
cb3-5	0.0001	1	11	5	6.73E-09	9.40E-05
cb3-ave	0.0001	1.0	11.0	5.0	6.73E-09	9.42E-05
cb3-1	0.001	1	11	5	6.73E-09	1.65E-04
cb3-2	0.001	1	11	5	6.73E-09	1.03E-04
cb3-3	0.001	1	11	5	6.73E-09	1.27E-04
cb3-4	0.001	1	11	5	6.73E-09	9.60E-05
cb3-5	0.001	1	11	5	6.73E-09	1.05E-04
cb3-ave	0.001	1.0	11.0	5.0	6.73E-09	1.19E-04
cb3-1	0.01	1	11	5	6.73E-09	1.36E-03
cb3-2	0.01	1	11	5	6.73E-09	4.33E-04
cb3-3	0.01	1	11	5	6.73E-09	8.62E-04
cb3-4	0.01	1	11	5	6.73E-09	2.24E-04
cb3-5	0.01	1	11	5	6.73E-09	4.84E-04
cb3-ave	0.01	1.0	11.0	5.0	6.73E-09	6.72E-04
chaconn1-1	0.0001	1	9	4	3.45E-06	2.01E-03
chaconn1-2	0.0001	1	9	4	2.28E-08	1.63E-04
chaconn1-3	0.0001	1	9	4	2.28E-08	1.63E-04
chaconn1-4	0.0001	1	9	4	1.00E-06	1.08E-03
chaconn1-5	0.0001	1	9	4	2.32E-06	1.65E-03
chaconn1-ave	0.0001	1.0	9.0	4.0	1.36E-06	1.01E-03
chaconn1-1	0.001	1	9	4	3.43E-05	6.33E-03
chaconn1-2	0.001	1	9	4	2.28E-08	1.69E-04
chaconn1-3	0.001	1	9	4	2.28E-08	1.88E-04
chaconn1-4	0.001	1	9	4	9.87E-06	3.40E-03
chaconn1-5	0.001	1	9	4	2.30E-05	5.19E-03
chaconn1-ave	0.001	1.0	9.0	4.0	1.35E-05	3.05E-03
chaconn1-1	0.01	1	9	4	3.43E-04	2.00E-02
chaconn1-2	0.01	1	9	4	2.28E-08	4.87E-04
chaconn1-3	0.01	1	9	4	2.28E-08	9.43E-04
chaconn1-4	0.01	1	9	4	9.86E-05	1.07E-02
chaconn1-5	0.01	1	9	4	2.30E-04	1.64E-02
chaconn1-ave	0.01	1.0	9.0	4.0	1.34E-04	9.72E-03

TABLE 2. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
chaconn2-1	0.0001	1	10	5	1.24E-08	1.28E-04
chaconn2-2	0.0001	1	10	5	1.24E-08	1.28E-04
chaconn2-3	0.0001	1	10	5	1.24E-08	1.28E-04
chaconn2-4	0.0001	1	10	5	1.24E-08	1.28E-04
chaconn2-5	0.0001	1	10	5	1.24E-08	1.28E-04
chaconn2-ave	0.0001	1.0	10.0	5.0	1.24E-08	1.28E-04
chaconn2-1	0.001	1	10	5	1.24E-08	1.86E-04
chaconn2-2	0.001	1	10	5	1.24E-08	1.34E-04
chaconn2-3	0.001	1	10	5	1.24E-08	1.54E-04
chaconn2-4	0.001	1	10	5	1.24E-08	1.29E-04
chaconn2-5	0.001	1	10	5	1.24E-08	1.36E-04
chaconn2-ave	0.001	1.0	10.0	5.0	1.24E-08	1.48E-04
chaconn2-1	0.01	1	10	5	1.24E-08	1.36E-03
chaconn2-2	0.01	1	10	5	1.24E-08	4.42E-04
chaconn2-3	0.01	1	10	5	1.24E-08	8.66E-04
chaconn2-4	0.01	1	10	5	1.24E-08	2.40E-04
chaconn2-5	0.01	1	10	5	1.24E-08	4.92E-04
chaconn2-ave	0.01	1.0	10.0	5.0	1.24E-08	6.80E-04
congigmz-1	0.0001	1	27	11	7.50E-06	1.65E-03
congigmz-2	0.0001	1	27	11	7.13E-06	1.61E-03
congigmz-3	0.0001	1	27	11	7.33E-06	1.63E-03
congigmz-4	0.0001	1	27	11	7.13E-06	1.61E-03
congigmz-5	0.0001	1	27	11	7.65E-06	1.67E-03
congigmz-ave	0.0001	1.0	27.0	11.0	7.35E-06	1.64E-03
congigmz-1	0.001	1	27	11	1.06E-05	1.97E-03
congigmz-2	0.001	1	27	11	7.14E-06	1.62E-03
congigmz-3	0.001	1	27	11	9.01E-06	1.81E-03
congigmz-4	0.001	1	27	11	7.15E-06	1.63E-03
congigmz-5	0.001	1	27	11	1.20E-05	2.09E-03
congigmz-ave	0.001	1.0	27.0	11.0	9.18E-06	1.83E-03
congigmz-1	0.01	1	27	11	2.77E-05	3.20E-03
congigmz-2	0.01	1	27	11	7.25E-06	2.56E-03
congigmz-3	0.01	1	27	11	2.15E-05	2.81E-03
congigmz-4	0.01	1	27	11	7.30E-06	3.13E-03
congigmz-5	0.01	1	27	10	1.77E-05	2.59E-03
congigmz-ave	0.01	1.0	27.0	10.8	1.63E-05	2.86E-03
csfi1-1	0.0001	1	39	16	4.92E-02	8.08E-02
csfi1-2	0.0001	1	42	22	4.91E-02	8.08E-02
csfi1-3	0.0001	1	35	13	2.46E-02	5.71E-02
csfi1-4	0.0001	1	38	17	2.46E-02	5.71E-02
csfi1-5	0.0001	1	48	23	4.92E-02	8.08E-02
csfi1-ave	0.0001	1.0	40.4	18.2	3.93E-02	7.13E-02
csfi1-1	0.001	1	44	15	4.92E-02	8.08E-02
csfi1-2	0.001	1	64	16	4.92E-02	8.08E-02
csfi1-3	0.001	1	36	14	2.46E-02	5.71E-02
csfi1-4	0.001	1	34	13	2.46E-02	5.71E-02
csfi1-5	0.001	1	40	26	4.92E-02	8.08E-02
csfi1-ave	0.001	1.0	43.6	16.8	3.94E-02	7.13E-02
csfi1-1	0.01	1	46	14	4.92E-02	8.09E-02
csfi1-2	0.01	1	46	16	4.92E-02	8.08E-02
csfi1-3	0.01	1	37	13	2.46E-02	5.71E-02
csfi1-4	0.01	1	31	14	2.46E-02	5.71E-02
csfi1-5	0.01	1	45	17	4.92E-02	8.08E-02
csfi1-ave	0.01	1.0	41.0	14.8	3.94E-02	7.14E-02

TABLE 3. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
csfi2-1	0.0001	1	90	16	6.29E-02	7.94E-02
csfi2-2	0.0001	1	82	20	1.15E-02	3.36E-02
csfi2-3	0.0001	1	79	11	2.60E-02	5.06E-02
csfi2-4	0.0001	1	82	18	1.15E-02	3.36E-02
csfi2-5	0.0001	1	77	11	2.60E-02	5.06E-02
csfi2-ave	0.0001	1.0	82.0	15.2	2.76E-02	4.95E-02
csfi2-1	0.001	1	86	16	6.29E-02	7.94E-02
csfi2-2	0.001	1	82	16	1.15E-02	3.36E-02
csfi2-3	0.001	1	77	11	2.60E-02	5.06E-02
csfi2-4	0.001	1	83	19	1.15E-02	3.36E-02
csfi2-5	0.001	1	78	11	2.60E-02	5.06E-02
csfi2-ave	0.001	1.0	81.2	14.6	2.76E-02	4.95E-02
csfi2-1	0.01	1	85	16	6.29E-02	7.95E-02
csfi2-2	0.01	1	84	17	1.15E-02	3.36E-02
csfi2-3	0.01	1	60	11	2.59E-02	5.06E-02
csfi2-4	0.01	1	83	17	1.15E-02	3.36E-02
csfi2-5	0.01	1	65	11	2.59E-02	5.05E-02
csfi2-ave	0.01	1.0	75.4	14.4	2.76E-02	4.95E-02
demymalo-1	0.0001	1	24	4	1.33E-08	1.68E-04
demymalo-2	0.0001	1	24	4	1.33E-08	1.67E-04
demymalo-3	0.0001	1	24	4	1.33E-08	1.68E-04
demymalo-4	0.0001	1	24	4	1.33E-08	1.67E-04
demymalo-5	0.0001	1	24	4	1.33E-08	1.67E-04
demymalo-ave	0.0001	1.0	24.0	4.0	1.33E-08	1.68E-04
demymalo-1	0.001	1	24	4	1.33E-08	2.32E-04
demymalo-2	0.001	1	24	4	1.33E-08	1.72E-04
demymalo-3	0.001	1	24	4	1.33E-08	1.86E-04
demymalo-4	0.001	1	24	4	1.33E-08	1.68E-04
demymalo-5	0.001	1	24	4	1.33E-08	1.70E-04
demymalo-ave	0.001	1.0	24.0	4.0	1.33E-08	1.86E-04
demymalo-1	0.01	1	23	4	1.33E-08	1.62E-03
demymalo-2	0.01	1	24	4	1.33E-08	4.36E-04
demymalo-3	0.01	1	23	4	1.33E-08	8.33E-04
demymalo-4	0.01	1	24	4	1.33E-08	2.09E-04
demymalo-5	0.01	1	24	4	1.33E-08	3.38E-04
demymalo-ave	0.01	1.0	23.6	4.0	1.33E-08	6.87E-04
disc2-1	0.0001	2	44	26	1.69E-01	1.47E+00
disc2-2	0.0001	4	52	20	1.54E-01	1.41E+00
disc2-3	0.0001	3	41	16	1.47E-01	1.38E+00
disc2-4	0.0001	3	45	16	1.47E-01	1.38E+00
disc2-5	0.0001	4	40	17	1.47E-01	1.38E+00
disc2-ave	0.0001	3.2	44.4	19.0	1.53E-01	1.41E+00
disc2-1	0.001	2	52	18	1.69E-01	1.47E+00
disc2-2	0.001	4	44	20	1.54E-01	1.41E+00
disc2-3	0.001	3	53	16	1.47E-01	1.38E+00
disc2-4	0.001	3	37	16	1.47E-01	1.38E+00
disc2-5	0.001	4	75	17	1.47E-01	1.38E+00
disc2-ave	0.001	3.2	52.2	17.4	1.53E-01	1.41E+00
disc2-1	0.01	2	36	35	1.70E-01	1.48E+00
disc2-2	0.01	4	38	18	1.55E-01	1.41E+00
disc2-3	0.01	3	53	29	1.53E-01	1.41E+00
disc2-4	0.01	3	35	45	6.31E-02	8.67E-01
disc2-5	0.01	4	48	18	1.47E-01	1.38E+00
disc2-ave	0.01	3.2	42.0	29.0	1.38E-01	1.31E+00

TABLE 4. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
eigmaxb-1	0.0001	9	12	3	2.12E-08	2.62E-04
eigmaxb-2	0.0001	11	12	3	2.12E-08	5.41E-04
eigmaxb-3	0.0001	4	12	3	2.12E-08	2.26E-04
eigmaxb-4	0.0001	13	12	3	2.12E-08	6.15E-04
eigmaxb-5	0.0001	9	12	3	2.12E-08	3.99E-04
eigmaxb-ave	0.0001	9.2	12.0	3.0	2.12E-08	4.09E-04
eigmaxb-1	0.001	9	12	3	2.13E-08	2.41E-03
eigmaxb-2	0.001	11	12	3	2.41E-08	5.31E-03
eigmaxb-3	0.001	4	12	3	2.13E-08	2.00E-03
eigmaxb-4	0.001	13	12	3	2.41E-08	6.06E-03
eigmaxb-5	0.001	9	12	3	2.19E-08	3.85E-03
eigmaxb-ave	0.001	9.2	12.0	3.0	2.25E-08	3.93E-03
eigmaxb-1	0.01	9	12	3	4.08E-08	2.40E-02
eigmaxb-2	0.01	11	13	4	2.30E-08	5.30E-02
eigmaxb-3	0.01	4	12	3	4.23E-08	2.00E-02
eigmaxb-4	0.01	13	12	4	2.28E-08	6.06E-02
eigmaxb-5	0.01	9	13	4	2.15E-08	3.85E-02
eigmaxb-ave	0.01	9.2	12.4	3.6	3.01E-08	3.92E-02
eigmaxc-1	0.0001	9	100	22	4.12E-10	1.46E-05
eigmaxc-2	0.0001	11	100	20	8.29E-09	6.50E-05
eigmaxc-3	0.0001	4	100	22	4.43E-10	1.50E-05
eigmaxc-4	0.0001	13	103	20	7.39E-09	6.29E-05
eigmaxc-5	0.0001	9	102	21	2.21E-09	3.67E-05
eigmaxc-ave	0.0001	9.2	101.0	21.0	3.75E-09	3.89E-05
eigmaxc-1	0.001	9	101	21	3.59E-09	4.57E-05
eigmaxc-2	0.001	11	100	20	8.29E-09	7.62E-05
eigmaxc-3	0.001	4	100	21	5.46E-09	5.31E-05
eigmaxc-4	0.001	13	104	21	5.01E-10	1.41E-04
eigmaxc-5	0.001	9	104	21	2.05E-09	1.57E-04
eigmaxc-ave	0.001	9.2	101.8	20.8	3.98E-09	9.45E-05
eigmaxc-1	0.01	9	102	21	2.27E-09	1.67E-04
eigmaxc-2	0.01	11	102	20	8.21E-09	4.05E-04
eigmaxc-3	0.01	4	101	21	6.27E-09	8.48E-05
eigmaxc-4	0.01	13	98	20	6.01E-09	1.40E-03
eigmaxc-5	0.01	9	115	21	1.92E-09	1.54E-03
eigmaxc-ave	0.01	9.2	103.6	20.6	4.94E-09	7.19E-04
eigminb-1	0.0001	9	9	3	1.56E-07	2.59E-03
eigminb-2	0.0001	11	9	3	1.56E-07	3.36E-03
eigminb-3	0.0001	4	9	3	1.56E-07	3.68E-04
eigminb-4	0.0001	13	9	3	1.56E-07	2.12E-03
eigminb-5	0.0001	9	9	3	1.55E-07	2.86E-03
eigminb-ave	0.0001	9.2	9.0	3.0	1.56E-07	2.26E-03
eigminb-1	0.001	9	9	3	1.58E-07	2.57E-02
eigminb-2	0.001	11	9	3	1.58E-07	3.34E-02
eigminb-3	0.001	4	9	3	1.55E-07	2.42E-03
eigminb-4	0.001	13	9	3	1.62E-07	2.11E-02
eigminb-5	0.001	9	9	3	1.55E-07	2.84E-02
eigminb-ave	0.001	9.2	9.0	3.0	1.58E-07	2.22E-02
eigminb-1	0.01	9	9	4	1.30E-07	2.57E-01
eigminb-2	0.01	11	9	4	8.31E-07	3.34E-01
eigminb-3	0.01	4	9	3	1.60E-07	2.40E-02
eigminb-4	0.01	13	9	4	4.49E-07	2.11E-01
eigminb-5	0.01	9	9	4	5.53E-07	2.84E-01
eigminb-ave	0.01	9.2	9.0	3.8	4.24E-07	2.22E-01

TABLE 5. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
eigminc-1	0.0001	9	13	4	9.24E-10	2.17E-05
eigminc-2	0.0001	11	13	4	9.24E-10	2.20E-05
eigminc-3	0.0001	4	13	4	9.24E-10	2.17E-05
eigminc-4	0.0001	13	13	4	9.24E-10	2.58E-05
eigminc-5	0.0001	9	13	4	9.24E-10	2.65E-05
eigminc-ave	0.0001	9.2	13.0	4.0	9.24E-10	2.36E-05
eigminc-1	0.001	9	13	4	9.24E-10	2.72E-05
eigminc-2	0.001	11	13	4	9.23E-10	4.55E-05
eigminc-3	0.001	4	13	4	9.24E-10	2.26E-05
eigminc-4	0.001	13	13	4	9.23E-10	1.42E-04
eigminc-5	0.001	9	13	4	9.23E-10	1.55E-04
eigminc-ave	0.001	9.2	13.0	4.0	9.23E-10	7.84E-05
eigminc-1	0.01	9	13	4	9.21E-10	1.65E-04
eigminc-2	0.01	11	13	4	9.18E-10	4.00E-04
eigminc-3	0.01	4	13	4	9.22E-10	6.69E-05
eigminc-4	0.01	13	13	4	9.17E-10	1.40E-03
eigminc-5	0.01	9	13	4	9.20E-10	1.54E-03
eigminc-ave	0.01	9.2	13.0	4.0	9.19E-10	7.13E-04
gigomez1-1	0.0001	1	19	4	5.19E-08	3.31E-04
gigomez1-2	0.0001	1	19	4	5.19E-08	3.31E-04
gigomez1-3	0.0001	1	19	4	5.19E-08	3.31E-04
gigomez1-4	0.0001	1	19	4	5.19E-08	3.31E-04
gigomez1-5	0.0001	1	19	4	5.19E-08	3.31E-04
gigomez1-ave	0.0001	1.0	19.0	4.0	5.19E-08	3.31E-04
gigomez1-1	0.001	1	19	4	5.19E-08	3.68E-04
gigomez1-2	0.001	1	19	4	5.19E-08	3.33E-04
gigomez1-3	0.001	1	19	4	5.19E-08	3.41E-04
gigomez1-4	0.001	1	19	4	5.19E-08	3.31E-04
gigomez1-5	0.001	1	19	4	5.19E-08	3.32E-04
gigomez1-ave	0.001	1.0	19.0	4.0	5.19E-08	3.41E-04
gigomez1-1	0.01	1	19	4	5.19E-08	1.65E-03
gigomez1-2	0.01	1	19	4	5.19E-08	5.21E-04
gigomez1-3	0.01	1	19	4	5.19E-08	8.81E-04
gigomez1-4	0.01	1	19	4	5.19E-08	3.54E-04
gigomez1-5	0.01	1	19	4	5.19E-08	4.42E-04
gigomez1-ave	0.01	1.0	19.0	4.0	5.19E-08	7.69E-04
gigomez2-1	0.0001	1	11	4	3.43E-06	2.00E-03
gigomez2-2	0.0001	1	11	4	3.80E-08	2.11E-04
gigomez2-3	0.0001	1	11	4	3.80E-08	2.11E-04
gigomez2-4	0.0001	1	11	4	9.83E-07	1.07E-03
gigomez2-5	0.0001	1	11	4	2.30E-06	1.64E-03
gigomez2-ave	0.0001	1.0	11.0	4.0	1.36E-06	1.03E-03
gigomez2-1	0.001	1	11	4	3.43E-05	6.33E-03
gigomez2-2	0.001	1	11	4	3.80E-08	2.16E-04
gigomez2-3	0.001	1	11	4	3.80E-08	2.30E-04
gigomez2-4	0.001	1	11	4	9.85E-06	3.39E-03
gigomez2-5	0.001	1	11	4	2.30E-05	5.19E-03
gigomez2-ave	0.001	1.0	11.0	4.0	1.34E-05	3.07E-03
gigomez2-1	0.01	1	11	4	3.43E-04	2.00E-02
gigomez2-2	0.01	1	11	4	3.80E-08	5.05E-04
gigomez2-3	0.01	1	11	4	3.80E-08	9.52E-04
gigomez2-4	0.01	1	11	4	9.86E-05	1.07E-02
gigomez2-5	0.01	1	11	4	2.30E-04	1.64E-02
gigomez2-ave	0.01	1.0	11.0	4.0	1.34E-04	9.72E-03

TABLE 6. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
gigomez3-1	0.0001	1	11	5	3.39E-08	2.11E-04
gigomez3-2	0.0001	1	11	5	3.39E-08	2.11E-04
gigomez3-3	0.0001	1	11	5	3.39E-08	2.11E-04
gigomez3-4	0.0001	1	11	5	3.39E-08	2.11E-04
gigomez3-5	0.0001	1	11	5	3.39E-08	2.11E-04
gigomez3-ave	0.0001	1.0	11.0	5.0	3.39E-08	2.11E-04
gigomez3-1	0.001	1	11	5	3.39E-08	2.51E-04
gigomez3-2	0.001	1	11	5	3.39E-08	2.15E-04
gigomez3-3	0.001	1	11	5	3.39E-08	2.27E-04
gigomez3-4	0.001	1	11	5	3.39E-08	2.12E-04
gigomez3-5	0.001	1	11	5	3.39E-08	2.16E-04
gigomez3-ave	0.001	1.0	11.0	5.0	3.39E-08	2.24E-04
gigomez3-1	0.01	1	11	5	3.39E-08	1.37E-03
gigomez3-2	0.01	1	11	5	3.39E-08	4.73E-04
gigomez3-3	0.01	1	11	5	3.39E-08	8.82E-04
gigomez3-4	0.01	1	11	5	3.39E-08	2.93E-04
gigomez3-5	0.01	1	11	5	3.39E-08	5.19E-04
gigomez3-ave	0.01	1.0	11.0	5.0	3.39E-08	7.08E-04
hadamard-1	0.0001	5	8	5	1.00E-08	1.49E+01
hadamard-2	0.0001	5	8	5	1.00E-08	1.49E+01
hadamard-3	0.0001	8	8	5	1.00E-08	1.49E+01
hadamard-4	0.0001	5	8	5	1.00E-08	1.49E+01
hadamard-5	0.0001	7	8	5	1.00E-08	1.49E+01
hadamard-ave	0.0001	6.0	8.0	5.0	1.00E-08	1.49E+01
hadamard-1	0.001	5	8	5	1.01E-08	1.49E+01
hadamard-2	0.001	5	8	5	1.02E-08	1.49E+01
hadamard-3	0.001	8	8	5	1.01E-08	1.49E+01
hadamard-4	0.001	5	8	5	1.01E-08	1.49E+01
hadamard-5	0.001	7	8	5	1.02E-08	1.49E+01
hadamard-ave	0.001	6.0	8.0	5.0	1.01E-08	1.49E+01
hadamard-1	0.01	5	8	5	1.08E-08	1.49E+01
hadamard-2	0.01	5	8	5	1.18E-08	1.49E+01
hadamard-3	0.01	8	8	5	1.13E-08	1.49E+01
hadamard-4	0.01	5	8	5	1.09E-08	1.49E+01
hadamard-5	0.01	7	8	5	1.17E-08	1.49E+01
hadamard-ave	0.01	6.0	8.0	5.0	1.13E-08	1.49E+01
het-z-1	0.0001	1	43	32	2.11E-09	1.65E-03
het-z-2	0.0001	1	43	33	8.51E-09	5.65E-03
het-z-3	0.0001	1	46	37	9.88E-04	1.78E-01
het-z-4	0.0001	1	46	50	9.97E-04	1.80E-01
het-z-5	0.0001	1	43	33	3.03E-10	1.00E-03
het-z-ave	0.0001	1.0	44.2	37.0	3.97E-04	7.31E-02
het-z-1	0.001	1	43	25	2.00E-09	4.99E-04
het-z-2	0.001	1	43	33	6.34E-09	3.53E-03
het-z-3	0.001	1	38	41	1.00E-03	2.03E-01
het-z-4	0.001	1	33	47	1.00E-03	1.43E-01
het-z-5	0.001	1	43	32	1.07E-08	2.70E-03
het-z-ave	0.001	1.0	40.0	35.6	4.00E-04	7.06E-02
het-z-1	0.01	1	43	43	2.49E-09	2.85E-03
het-z-2	0.01	1	43	34	2.98E-09	1.06E-03
het-z-3	0.01	1	31	43	1.00E-03	4.45E-01
het-z-4	0.01	1	30	35	1.00E-03	5.19E-01
het-z-5	0.01	1	43	49	5.78E-10	5.74E-03
het-z-ave	0.01	1.0	38.0	40.8	4.00E-04	1.95E-01

TABLE 7. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
hs010-1	0.0001	1	49	4	2.36E-05	4.58E-03
hs010-2	0.0001	1	53	4	2.91E-06	1.61E-03
hs010-3	0.0001	1	49	4	1.06E-05	3.08E-03
hs010-4	0.0001	1	48	4	1.37E-05	3.49E-03
hs010-5	0.0001	1	48	4	3.45E-05	5.54E-03
hs010-ave	0.0001	1.0	49.4	4.0	1.71E-05	3.66E-03
hs010-1	0.001	1	49	4	2.36E-04	1.45E-02
hs010-2	0.001	1	50	4	2.94E-05	5.11E-03
hs010-3	0.001	1	54	4	1.06E-04	9.72E-03
hs010-4	0.001	1	54	4	1.37E-04	1.10E-02
hs010-5	0.001	1	49	4	3.45E-04	1.75E-02
hs010-ave	0.001	1.0	51.2	4.0	1.71E-04	1.16E-02
hs010-1	0.01	1	49	4	2.38E-03	4.60E-02
hs010-2	0.01	1	48	4	2.94E-04	1.62E-02
hs010-3	0.01	1	48	4	1.06E-03	3.07E-02
hs010-4	0.01	1	48	4	1.37E-03	3.49E-02
hs010-5	0.01	1	49	4	3.41E-03	5.51E-02
hs010-ave	0.01	1.0	48.4	4.0	1.70E-03	3.66E-02
hs034-1	0.0001	1	14	11	7.96E-10	6.61E-05
hs034-2	0.0001	1	14	11	7.96E-10	6.61E-05
hs034-3	0.0001	1	14	11	7.96E-10	6.68E-05
hs034-4	0.0001	1	14	11	7.96E-10	6.63E-05
hs034-5	0.0001	1	14	11	7.96E-10	6.91E-05
hs034-ave	0.0001	1.0	14.0	11.0	7.96E-10	6.69E-05
hs034-1	0.001	1	14	11	7.96E-10	7.90E-05
hs034-2	0.001	1	14	11	7.96E-10	7.86E-05
hs034-3	0.001	1	14	11	7.97E-10	1.19E-04
hs034-4	0.001	1	14	11	7.96E-10	9.02E-05
hs034-5	0.001	1	14	11	7.98E-10	2.14E-04
hs034-ave	0.001	1.0	14.0	11.0	7.97E-10	1.16E-04
hs034-1	0.01	1	14	11	7.96E-10	4.39E-04
hs034-2	0.01	1	14	11	8.00E-10	4.31E-04
hs034-3	0.01	1	14	11	8.06E-10	9.96E-04
hs034-4	0.01	1	14	11	7.96E-10	6.18E-04
hs034-5	0.01	1	14	11	8.18E-10	2.03E-03
hs034-ave	0.01	1.0	14.0	11.0	8.03E-10	9.03E-04
hs039-1	0.0001	1	21	8	2.28E-06	9.72E-04
hs039-2	0.0001	1	9	8	2.65E-08	1.07E-04
hs039-3	0.0001	1	21	8	1.73E-06	8.46E-04
hs039-4	0.0001	1	23	8	6.77E-06	1.68E-03
hs039-5	0.0001	1	9	8	2.65E-08	1.06E-04
hs039-ave	0.0001	1.0	16.6	8.0	2.17E-06	7.41E-04
hs039-1	0.001	1	25	8	2.28E-05	3.07E-03
hs039-2	0.001	1	9	8	2.65E-08	2.38E-04
hs039-3	0.001	1	25	8	1.73E-05	2.67E-03
hs039-4	0.001	1	29	8	6.77E-05	5.30E-03
hs039-5	0.001	1	9	8	2.65E-08	2.05E-04
hs039-ave	0.001	1.0	19.4	8.0	2.16E-05	2.30E-03
hs039-1	0.01	1	99	8	2.28E-04	9.72E-03
hs039-2	0.01	1	9	8	2.63E-08	2.13E-03
hs039-3	0.01	1	30	8	1.73E-04	8.45E-03
hs039-4	0.01	1	40	8	6.77E-04	1.68E-02
hs039-5	0.01	1	9	8	2.67E-08	1.76E-03
hs039-ave	0.01	1.0	37.4	8.0	2.16E-04	7.76E-03

TABLE 8. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
hs066-1	0.0001	1	13	17	4.02E-05	7.97E-03
hs066-2	0.0001	1	13	17	4.74E-06	2.74E-03
hs066-3	0.0001	1	13	17	9.59E-06	3.89E-03
hs066-4	0.0001	1	13	17	6.00E-06	3.08E-03
hs066-5	0.0001	1	13	17	1.40E-05	4.71E-03
hs066-ave	0.0001	1.0	13.0	17.0	1.49E-05	4.48E-03
hs066-1	0.001	1	13	17	4.02E-04	2.52E-02
hs066-2	0.001	1	13	17	4.73E-05	8.65E-03
hs066-3	0.001	1	13	17	9.57E-05	1.23E-02
hs066-4	0.001	1	13	17	6.01E-05	9.75E-03
hs066-5	0.001	1	13	17	1.40E-04	1.49E-02
hs066-ave	0.001	1.0	13.0	17.0	1.49E-04	1.42E-02
hs066-1	0.01	1	13	17	4.03E-03	7.98E-02
hs066-2	0.01	1	13	17	4.72E-04	2.73E-02
hs066-3	0.01	1	13	16	9.56E-04	3.89E-02
hs066-4	0.01	1	13	17	6.01E-04	3.08E-02
hs066-5	0.01	1	13	17	1.40E-03	4.71E-02
hs066-ave	0.01	1.0	13.0	16.8	1.49E-03	4.48E-02
hs072-1	0.0001	1	21	20	2.18E-06	5.87E-06
hs072-2	0.0001	1	21	20	1.40E-05	8.78E-06
hs072-3	0.0001	1	21	20	2.21E-06	9.46E-06
hs072-4	0.0001	1	21	20	1.75E-06	1.50E-06
hs072-5	0.0001	1	21	20	6.46E-06	1.67E-05
hs072-ave	0.0001	1.0	21.0	20.0	5.32E-06	8.47E-06
hs072-1	0.001	1	21	20	2.18E-05	5.55E-05
hs072-2	0.001	1	21	20	1.40E-04	8.86E-05
hs072-3	0.001	1	21	20	2.20E-05	9.14E-05
hs072-4	0.001	1	21	20	1.75E-05	1.15E-05
hs072-5	0.001	1	21	20	6.46E-05	1.64E-04
hs072-ave	0.001	1.0	21.0	20.0	5.32E-05	8.22E-05
hs072-1	0.01	1	21	20	2.18E-04	5.51E-04
hs072-2	0.01	1	21	20	1.41E-03	8.88E-04
hs072-3	0.01	1	21	20	2.20E-04	9.11E-04
hs072-4	0.01	1	21	20	1.75E-04	1.11E-04
hs072-5	0.01	1	21	17	6.45E-04	1.64E-03
hs072-ave	0.01	1.0	21.0	19.4	5.33E-04	8.19E-04
hs073-1	0.0001	1	16	14	9.73E-07	6.69E-05
hs073-2	0.0001	1	16	14	9.70E-07	6.66E-05
hs073-3	0.0001	1	16	14	9.70E-07	6.93E-05
hs073-4	0.0001	1	16	14	9.79E-07	8.57E-05
hs073-5	0.0001	1	16	14	9.88E-07	9.65E-05
hs073-ave	0.0001	1.0	16.0	14.0	9.76E-07	7.70E-05
hs073-1	0.001	1	16	14	9.67E-07	9.34E-05
hs073-2	0.001	1	16	14	9.42E-07	7.95E-05
hs073-3	0.001	1	16	14	1.01E-06	2.07E-04
hs073-4	0.001	1	16	14	4.93E-07	5.40E-04
hs073-5	0.001	1	16	14	3.70E-07	6.96E-04
hs073-ave	0.001	1.0	16.0	14.0	7.56E-07	3.23E-04
hs073-1	0.01	1	16	14	1.06E-06	6.61E-04
hs073-2	0.01	1	16	14	8.15E-07	4.55E-04
hs073-3	0.01	1	17	14	3.88E-07	1.95E-03
hs073-4	0.01	1	16	14	4.82E-07	5.38E-03
hs073-5	0.01	1	17	14	1.79E-07	6.95E-03
hs073-ave	0.01	1.0	16.4	14.0	5.86E-07	3.08E-03

TABLE 9. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
hs106-1	0.0001	1	48	9	7.30E-07	8.60E-06
hs106-2	0.0001	1	75	9	2.36E-05	5.65E-05
hs106-3	0.0001	1	56	9	9.88E-07	9.76E-06
hs106-4	0.0001	2	81	9	1.22E-05	4.86E-05
hs106-5	0.0001	1	89	9	5.60E-06	2.43E-05
hs106-ave	0.0001	1.2	69.8	9.0	8.64E-06	2.96E-05
hs106-1	0.001	1	58	9	8.74E-06	3.78E-05
hs106-2	0.001	1	112	9	2.38E-04	3.48E-04
hs106-3	0.001	1	101	9	8.29E-06	3.17E-05
hs106-4	0.001	2	38	9	1.24E-04	3.66E-04
hs106-5	0.001	1	48	9	5.64E-05	1.11E-04
hs106-ave	0.001	1.2	71.4	9.0	8.71E-05	1.79E-04
hs106-1	0.01	1	51	9	8.88E-05	2.65E-04
hs106-2	0.01	1	60	9	2.39E-03	3.18E-03
hs106-3	0.01	1	71	9	8.13E-05	1.73E-04
hs106-4	0.01	2	35	9	1.24E-03	3.52E-03
hs106-5	0.01	1	112	9	5.63E-04	8.72E-04
hs106-ave	0.01	1.2	65.8	9.0	8.73E-04	1.60E-03
madsen-1	0.0001	1	21	5	4.40E-08	1.81E-04
madsen-2	0.0001	1	21	5	4.40E-08	1.79E-04
madsen-3	0.0001	1	21	5	4.40E-08	1.79E-04
madsen-4	0.0001	1	20	5	8.78E-06	2.53E-03
madsen-5	0.0001	1	21	5	2.04E-05	3.86E-03
madsen-ave	0.0001	1.0	20.8	5.0	5.87E-06	1.39E-03
madsen-1	0.001	1	17	5	4.40E-08	2.97E-04
madsen-2	0.001	1	21	5	4.40E-08	1.85E-04
madsen-3	0.001	1	21	5	4.40E-08	2.02E-04
madsen-4	0.001	1	21	5	8.74E-05	7.98E-03
madsen-5	0.001	1	20	5	2.04E-04	1.22E-02
madsen-ave	0.001	1.0	20.0	5.0	5.83E-05	4.17E-03
madsen-1	0.01	1	18	5	4.43E-08	2.38E-03
madsen-2	0.01	1	20	5	4.40E-08	4.99E-04
madsen-3	0.01	1	20	5	4.39E-08	9.59E-04
madsen-4	0.01	1	17	5	8.75E-04	2.53E-02
madsen-5	0.01	1	17	5	2.05E-03	3.86E-02
madsen-ave	0.01	1.0	18.4	5.0	5.84E-04	1.35E-02
madsschj-1	0.0001	8	73	12	2.50E-07	1.29E-02
madsschj-2	0.0001	10	74	12	1.02E-06	2.60E-02
madsschj-3	0.0001	10	73	12	3.59E-07	1.54E-02
madsschj-4	0.0001	4	73	12	2.44E-07	1.27E-02
madsschj-5	0.0001	9	74	12	4.37E-07	1.70E-02
madsschj-ave	0.0001	8.2	73.4	12.0	4.62E-07	1.68E-02
madsschj-1	0.001	8	72	12	1.51E-06	3.16E-02
madsschj-2	0.001	10	72	12	9.47E-06	7.92E-02
madsschj-3	0.001	10	72	12	3.27E-06	4.65E-02
madsschj-4	0.001	4	73	12	4.18E-07	1.66E-02
madsschj-5	0.001	9	72	12	3.24E-06	4.63E-02
madsschj-ave	0.001	8.2	72.2	12.0	3.58E-06	4.40E-02
madsschj-1	0.01	8	80	12	1.54E-05	1.01E-01
madsschj-2	0.01	10	74	12	9.42E-05	2.50E-01
madsschj-3	0.01	10	68	12	3.31E-05	1.48E-01
madsschj-4	0.01	4	67	12	3.01E-06	4.46E-02
madsschj-5	0.01	9	73	12	3.18E-05	1.45E-01
madsschj-ave	0.01	8.2	72.4	12.0	3.55E-05	1.38E-01

TABLE 10. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
makela1-1	0.0001	1	25	4	1.14E-05	3.16E-03
makela1-2	0.0001	1	11	4	4.80E-08	2.05E-04
makela1-3	0.0001	1	11	4	4.80E-08	2.05E-04
makela1-4	0.0001	1	21	4	2.56E-06	1.50E-03
makela1-5	0.0001	1	23	4	5.99E-06	2.29E-03
makela1-ave	0.0001	1.0	18.2	4.0	4.01E-06	1.47E-03
makela1-1	0.001	1	28	4	1.14E-04	1.00E-02
makela1-2	0.001	1	11	4	4.80E-08	2.11E-04
makela1-3	0.001	1	11	4	4.80E-08	2.27E-04
makela1-4	0.001	1	26	4	2.56E-05	4.74E-03
makela1-5	0.001	1	27	4	5.99E-05	7.25E-03
makela1-ave	0.001	1.0	20.6	4.0	3.99E-05	4.48E-03
makela1-1	0.01	1	33	4	1.14E-03	3.16E-02
makela1-2	0.01	1	12	4	4.80E-08	5.20E-04
makela1-3	0.01	1	12	4	4.80E-08	9.88E-04
makela1-4	0.01	1	31	4	2.57E-04	1.50E-02
makela1-5	0.01	1	32	4	6.00E-04	2.29E-02
makela1-ave	0.01	1.0	24.0	4.0	3.98E-04	1.42E-02
makela2-1	0.0001	1	18	6	1.60E-06	2.08E-03
makela2-2	0.0001	1	18	6	2.26E-08	2.46E-04
makela2-3	0.0001	1	18	6	2.26E-08	2.46E-04
makela2-4	0.0001	1	18	6	7.20E-07	1.39E-03
makela2-5	0.0001	1	18	6	1.68E-06	2.13E-03
makela2-ave	0.0001	1.0	18.0	6.0	8.10E-07	1.22E-03
makela2-1	0.001	1	18	6	1.60E-05	6.57E-03
makela2-2	0.001	1	18	6	2.26E-08	2.51E-04
makela2-3	0.001	1	18	6	2.26E-08	2.65E-04
makela2-4	0.001	1	18	6	7.21E-06	4.40E-03
makela2-5	0.001	1	18	6	1.68E-05	6.73E-03
makela2-ave	0.001	1.0	18.0	6.0	8.03E-06	3.64E-03
makela2-1	0.01	1	18	6	1.60E-04	2.08E-02
makela2-2	0.01	1	18	6	2.25E-08	5.47E-04
makela2-3	0.01	1	18	6	2.25E-08	1.02E-03
makela2-4	0.01	1	18	6	7.21E-05	1.39E-02
makela2-5	0.01	1	18	6	1.68E-04	2.13E-02
makela2-ave	0.01	1.0	18.0	6.0	8.02E-05	1.15E-02
mifflin1-1	0.0001	1	48	4	2.58E-05	4.62E-03
mifflin1-2	0.0001	1	46	4	1.58E-08	1.15E-04
mifflin1-3	0.0001	1	46	4	1.58E-08	1.15E-04
mifflin1-4	0.0001	1	52	4	1.58E-08	1.15E-04
mifflin1-5	0.0001	1	112	4	1.58E-08	1.15E-04
mifflin1-ave	0.0001	1.0	60.8	4.0	5.17E-06	1.02E-03
mifflin1-1	0.001	1	52	4	2.58E-04	1.46E-02
mifflin1-2	0.001	1	49	4	1.58E-08	1.23E-04
mifflin1-3	0.001	1	53	4	1.58E-08	1.47E-04
mifflin1-4	0.001	1	47	4	1.58E-08	1.28E-04
mifflin1-5	0.001	1	45	4	1.58E-08	1.77E-04
mifflin1-ave	0.001	1.0	49.2	4.0	5.16E-05	3.04E-03
mifflin1-1	0.01	1	44	4	2.58E-03	4.62E-02
mifflin1-2	0.01	1	48	4	1.58E-08	4.70E-04
mifflin1-3	0.01	1	56	4	1.58E-08	9.31E-04
mifflin1-4	0.01	1	77	4	1.58E-08	5.91E-04
mifflin1-5	0.01	1	73	4	1.59E-08	1.36E-03
mifflin1-ave	0.01	1.0	59.6	4.0	5.16E-04	9.92E-03

TABLE 11. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
mifflin2-1	0.0001	1	41	5	1.37E-08	9.42E-05
mifflin2-2	0.0001	1	64	5	1.37E-08	9.47E-05
mifflin2-3	0.0001	1	65	5	1.37E-08	9.41E-05
mifflin2-4	0.0001	1	62	5	1.37E-08	9.52E-05
mifflin2-5	0.0001	1	62	5	1.37E-08	9.45E-05
mifflin2-ave	0.0001	1.0	58.8	5.0	1.37E-08	9.46E-05
mifflin2-1	0.001	1	63	5	1.37E-08	1.08E-04
mifflin2-2	0.001	1	44	5	1.37E-08	1.43E-04
mifflin2-3	0.001	1	43	5	1.37E-08	1.00E-04
mifflin2-4	0.001	1	53	5	1.37E-08	1.73E-04
mifflin2-5	0.001	1	45	5	1.37E-08	1.32E-04
mifflin2-ave	0.001	1.0	49.6	5.0	1.37E-08	1.31E-04
mifflin2-1	0.01	1	62	5	1.37E-08	5.39E-04
mifflin2-2	0.01	1	48	5	1.37E-08	1.08E-03
mifflin2-3	0.01	1	48	5	1.37E-08	3.55E-04
mifflin2-4	0.01	1	41	5	1.37E-08	1.45E-03
mifflin2-5	0.01	1	54	5	1.37E-08	9.33E-04
mifflin2-ave	0.01	1.0	50.6	5.0	1.37E-08	8.72E-04
minmaxrb-1	0.0001	1	9	7	5.24E-09	4.68E-01
minmaxrb-2	0.0001	1	9	7	5.23E-09	4.68E-01
minmaxrb-3	0.0001	1	9	7	5.23E-09	4.68E-01
minmaxrb-4	0.0001	1	9	7	5.23E-09	4.68E-01
minmaxrb-5	0.0001	1	9	7	5.23E-09	4.68E-01
minmaxrb-ave	0.0001	1.0	9.0	7.0	5.24E-09	4.68E-01
minmaxrb-1	0.001	1	9	7	5.25E-09	4.68E-01
minmaxrb-2	0.001	1	9	7	5.23E-09	4.68E-01
minmaxrb-3	0.001	1	9	7	5.23E-09	4.68E-01
minmaxrb-4	0.001	1	9	7	5.23E-09	4.68E-01
minmaxrb-5	0.001	1	9	7	5.23E-09	4.68E-01
minmaxrb-ave	0.001	1.0	9.0	7.0	5.24E-09	4.68E-01
minmaxrb-1	0.01	1	9	7	5.50E-09	4.68E-01
minmaxrb-2	0.01	1	9	7	5.23E-09	4.67E-01
minmaxrb-3	0.01	1	9	7	5.22E-09	4.67E-01
minmaxrb-4	0.01	1	9	7	5.23E-09	4.68E-01
minmaxrb-5	0.01	1	9	7	5.23E-09	4.68E-01
minmaxrb-ave	0.01	1.0	9.0	7.0	5.28E-09	4.67E-01
polak1-1	0.0001	1	56	4	4.14E-08	2.30E-04
polak1-2	0.0001	1	48	4	4.14E-08	2.30E-04
polak1-3	0.0001	1	20	4	6.93E-04	2.97E-02
polak1-4	0.0001	1	31	4	4.14E-08	2.30E-04
polak1-5	0.0001	1	33	4	4.14E-08	2.30E-04
polak1-ave	0.0001	1.0	37.6	4.0	1.39E-04	6.13E-03
polak1-1	0.001	1	18	4	4.14E-08	2.35E-04
polak1-2	0.001	1	29	4	4.14E-08	2.34E-04
polak1-3	0.001	1	27	4	6.93E-03	9.40E-02
polak1-4	0.001	1	28	4	4.14E-08	2.61E-04
polak1-5	0.001	1	25	4	4.14E-08	2.40E-04
polak1-ave	0.001	1.0	25.4	4.0	1.39E-03	1.90E-02
polak1-1	0.01	1	25	4	4.14E-08	5.27E-04
polak1-2	0.01	1	27	4	4.14E-08	5.11E-04
polak1-3	0.01	1	36	4	6.93E-02	2.97E-01
polak1-4	0.01	1	33	4	4.13E-08	1.27E-03
polak1-5	0.01	1	24	4	4.14E-08	7.11E-04
polak1-ave	0.01	1.0	29.0	4.0	1.39E-02	6.01E-02

TABLE 12. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
polak4-1	0.0001	1	9	8	1.87E-05	2.98E-01
polak4-2	0.0001	1	9	8	5.19E-07	3.00E-01
polak4-3	0.0001	1	9	8	5.19E-07	3.00E-01
polak4-4	0.0001	1	9	8	5.19E-07	3.00E-01
polak4-5	0.0001	1	9	8	5.19E-07	3.00E-01
polak4-ave	0.0001	1.0	9.0	8.0	4.16E-06	3.00E-01
polak4-1	0.001	1	24	12	7.88E-05	6.98E-01
polak4-2	0.001	1	9	8	5.19E-07	3.00E-01
polak4-3	0.001	1	9	8	5.19E-07	3.00E-01
polak4-4	0.001	1	9	8	5.19E-07	3.00E-01
polak4-5	0.001	1	9	8	5.19E-07	3.00E-01
polak4-ave	0.001	1.0	12.0	8.8	1.62E-05	3.80E-01
polak4-1	0.01	1	25	14	7.79E-04	7.05E-01
polak4-2	0.01	1	9	8	5.19E-07	3.01E-01
polak4-3	0.01	1	9	8	5.19E-07	3.01E-01
polak4-4	0.01	1	9	8	5.19E-07	3.00E-01
polak4-5	0.01	1	9	8	5.19E-07	3.00E-01
polak4-ave	0.01	1.0	12.2	9.2	1.56E-04	3.81E-01
polak6-1	0.0001	1	20	5	1.33E-07	1.41E-03
polak6-2	0.0001	1	20	5	1.08E-07	1.27E-03
polak6-3	0.0001	1	20	5	1.12E-07	1.29E-03
polak6-4	0.0001	1	20	5	5.71E-08	9.24E-04
polak6-5	0.0001	1	20	5	2.30E-07	1.85E-03
polak6-ave	0.0001	1.0	20.0	5.0	1.28E-07	1.35E-03
polak6-1	0.001	1	20	5	1.19E-06	4.22E-03
polak6-2	0.001	1	20	5	9.29E-07	3.73E-03
polak6-3	0.001	1	20	5	9.48E-07	3.77E-03
polak6-4	0.001	1	20	5	5.71E-08	9.35E-04
polak6-5	0.001	1	20	5	2.35E-06	5.94E-03
polak6-ave	0.001	1.0	20.0	5.0	1.10E-06	3.72E-03
polak6-1	0.01	1	20	5	1.19E-05	1.33E-02
polak6-2	0.01	1	20	5	9.28E-06	1.18E-02
polak6-3	0.01	1	20	5	9.45E-06	1.19E-02
polak6-4	0.01	1	20	5	5.70E-08	1.67E-03
polak6-5	0.01	1	20	5	2.37E-05	1.88E-02
polak6-ave	0.01	1.0	20.0	5.0	1.09E-05	1.15E-02
prodpl0-1	0.0001	6	17	16	1.34E-06	1.38E-04
prodpl0-2	0.0001	8	17	16	1.34E-06	1.36E-04
prodpl0-3	0.0001	4	17	16	1.34E-06	1.35E-04
prodpl0-4	0.0001	10	17	16	1.33E-06	1.35E-04
prodpl0-5	0.0001	7	17	16	1.33E-06	1.36E-04
prodpl0-ave	0.0001	7.0	17.0	16.0	1.34E-06	1.36E-04
prodpl0-1	0.001	6	17	16	1.42E-06	3.15E-04
prodpl0-2	0.001	8	17	16	1.36E-06	1.84E-04
prodpl0-3	0.001	4	17	16	1.36E-06	1.43E-04
prodpl0-4	0.001	10	17	16	1.35E-06	1.49E-04
prodpl0-5	0.001	7	17	16	1.33E-06	2.19E-04
prodpl0-ave	0.001	7.0	17.0	16.0	1.36E-06	2.02E-04
prodpl0-1	0.01	6	17	17	1.51E-07	2.83E-03
prodpl0-2	0.01	8	17	16	1.66E-06	1.24E-03
prodpl0-3	0.01	4	17	16	1.64E-06	4.58E-04
prodpl0-4	0.01	10	17	16	1.47E-06	6.34E-04
prodpl0-5	0.01	7	17	16	1.36E-06	1.73E-03
prodpl0-ave	0.01	7.0	17.0	16.2	1.25E-06	1.38E-03

TABLE 13. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
prodpl1-1	0.0001	5	17	16	2.15E-07	1.02E-04
prodpl1-2	0.0001	6	17	16	2.15E-07	1.04E-04
prodpl1-3	0.0001	8	17	16	2.15E-07	1.02E-04
prodpl1-4	0.0001	4	17	16	2.15E-07	1.02E-04
prodpl1-5	0.0001	10	17	16	2.15E-07	1.04E-04
prodpl1-ave	0.0001	6.6	17.0	16.0	2.15E-07	1.03E-04
prodpl1-1	0.001	5	17	16	2.16E-07	1.22E-04
prodpl1-2	0.001	6	17	16	2.15E-07	2.47E-04
prodpl1-3	0.001	8	17	16	2.16E-07	1.46E-04
prodpl1-4	0.001	4	17	16	2.16E-07	1.36E-04
prodpl1-5	0.001	10	17	16	2.16E-07	2.67E-04
prodpl1-ave	0.001	6.6	17.0	16.0	2.16E-07	1.84E-04
prodpl1-1	0.01	5	17	16	2.17E-07	6.79E-04
prodpl1-2	0.01	6	17	16	2.10E-07	2.25E-03
prodpl1-3	0.01	8	17	16	2.23E-07	1.06E-03
prodpl1-4	0.01	4	17	16	2.19E-07	9.09E-04
prodpl1-5	0.01	10	17	16	2.40E-07	2.48E-03
prodpl1-ave	0.01	6.6	17.0	16.0	2.22E-07	1.47E-03
rosenmmx-1	0.0001	1	44	5	1.22E-07	1.35E-03
rosenmmx-2	0.0001	1	44	5	1.03E-07	1.24E-03
rosenmmx-3	0.0001	1	48	5	1.02E-07	1.23E-03
rosenmmx-4	0.0001	1	43	5	3.76E-08	7.51E-04
rosenmmx-5	0.0001	1	44	5	2.53E-07	1.95E-03
rosenmmx-ave	0.0001	1.0	44.6	5.0	1.23E-07	1.30E-03
rosenmmx-1	0.001	1	44	5	1.18E-06	4.21E-03
rosenmmx-2	0.001	1	47	5	9.32E-07	3.74E-03
rosenmmx-3	0.001	1	47	5	9.45E-07	3.76E-03
rosenmmx-4	0.001	1	41	5	3.76E-08	7.63E-04
rosenmmx-5	0.001	1	44	5	2.38E-06	5.97E-03
rosenmmx-ave	0.001	1.0	44.6	5.0	1.10E-06	3.69E-03
rosenmmx-1	0.01	1	43	5	1.18E-05	1.33E-02
rosenmmx-2	0.01	1	44	5	9.28E-06	1.18E-02
rosenmmx-3	0.01	1	42	5	9.44E-06	1.19E-02
rosenmmx-4	0.01	1	44	5	3.76E-08	1.58E-03
rosenmmx-5	0.01	1	44	5	2.37E-05	1.88E-02
rosenmmx-ave	0.01	1.0	43.4	5.0	1.09E-05	1.15E-02
smmpsf-1	0.0001	16	120	90	4.79E-06	3.03E+00
smmpsf-2	0.0001	24	125	80	1.52E-05	2.92E+00
smmpsf-3	0.0001	20	125	77	6.82E-06	3.85E+00
smmpsf-4	0.0001	17	129	163	8.46E-07	2.90E+00
smmpsf-5	0.0001	25	125	155	8.69E-07	3.02E+00
smmpsf-ave	0.0001	20.4	124.8	113.0	5.71E-06	3.14E+00
smmpsf-1	0.001	16	130	81	1.86E-06	2.01E+00
smmpsf-2	0.001	24	130	77	1.48E-05	3.70E+00
smmpsf-3	0.001	20	133	167	9.94E-07	2.66E+00
smmpsf-4	0.001	17	125	147	7.45E-07	2.78E+00
smmpsf-5	0.001	25	131	150	1.05E-06	3.50E+00
smmpsf-ave	0.001	20.4	129.8	124.4	3.89E-06	2.93E+00
smmpsf-1	0.01	16	57	155	9.03E-07	3.47E+00
smmpsf-2	0.01	24	126	70	6.92E-06	3.60E+00
smmpsf-3	0.01	20	122	78	8.31E-06	3.73E+00
smmpsf-4	0.01	17	131	86	8.13E-06	2.67E+00
smmpsf-5	0.01	25	129	82	3.14E-06	2.99E+00
smmpsf-ave	0.01	20.4	113.0	94.2	5.48E-06	3.29E+00

TABLE 14. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
spiral-1	0.0001	1	22	12	1.69E+02	2.76E+02
spiral-2	0.0001	1	30	12	1.69E+02	2.76E+02
spiral-3	0.0001	1	28	12	1.69E+02	2.76E+02
spiral-4	0.0001	1	30	12	1.69E+02	2.76E+02
spiral-5	0.0001	1	116	12	1.69E+02	2.76E+02
spiral-ave	0.0001	1.0	45.2	12.0	1.69E+02	2.76E+02
spiral-1	0.001	1	32	12	1.69E+02	2.76E+02
spiral-2	0.001	1	31	12	1.69E+02	2.76E+02
spiral-3	0.001	1	31	12	1.69E+02	2.76E+02
spiral-4	0.001	1	31	12	1.69E+02	2.76E+02
spiral-5	0.001	1	9	12	1.69E+02	2.76E+02
spiral-ave	0.001	1.0	26.8	12.0	1.69E+02	2.76E+02
spiral-1	0.01	1	94	12	1.69E+02	2.76E+02
spiral-2	0.01	1	52	12	1.69E+02	2.76E+02
spiral-3	0.01	1	217	12	1.69E+02	2.76E+02
spiral-4	0.01	1	126	12	1.69E+02	2.76E+02
spiral-5	0.01	1	22	12	1.69E+02	2.76E+02
spiral-ave	0.01	1.0	102.2	12.0	1.69E+02	2.76E+02
swopf-1	0.0001	8	18	13	7.49E-04	1.51E-02
swopf-2	0.0001	10	18	13	3.05E-04	9.66E-03
swopf-3	0.0001	9	18	13	3.88E-04	1.09E-02
swopf-4	0.0001	5	18	13	2.93E-04	9.46E-03
swopf-5	0.0001	10	18	13	1.01E-03	1.76E-02
swopf-ave	0.0001	8.4	18.0	13.0	5.49E-04	1.25E-02
swopf-1	0.001	8	18	13	7.49E-03	4.79E-02
swopf-2	0.001	10	19	13	3.05E-03	3.05E-02
swopf-3	0.001	9	23	16	3.89E-03	3.45E-02
swopf-4	0.001	5	18	13	2.93E-03	2.99E-02
swopf-5	0.001	10	19	13	1.01E-02	5.57E-02
swopf-ave	0.001	8.4	19.4	13.6	5.50E-03	3.97E-02
swopf-1	0.01	8	18	14	7.30E-02	1.50E-01
swopf-2	0.01	10	17	14	3.00E-02	9.61E-02
swopf-3	0.01	9	18	14	1.44E-01	2.10E-01
swopf-4	0.01	5	19	14	2.99E-02	9.57E-02
swopf-5	0.01	10	17	14	1.04E-01	1.79E-01
swopf-ave	0.01	8.4	17.8	14.0	7.62E-02	1.46E-01
tenbars1-1	0.0001	2	21	6	1.16E-05	1.54E-03
tenbars1-2	0.0001	2	21	6	2.48E-06	7.10E-04
tenbars1-3	0.0001	3	21	6	1.47E-06	5.45E-04
tenbars1-4	0.0001	1	21	6	5.56E-06	1.06E-03
tenbars1-5	0.0001	2	21	6	9.30E-07	4.35E-04
tenbars1-ave	0.0001	2.0	21.0	6.0	4.42E-06	8.58E-04
tenbars1-1	0.001	2	21	6	1.16E-04	4.86E-03
tenbars1-2	0.001	2	21	6	2.48E-05	2.24E-03
tenbars1-3	0.001	3	21	6	1.47E-05	1.73E-03
tenbars1-4	0.001	1	21	6	5.56E-05	3.36E-03
tenbars1-5	0.001	2	21	6	9.23E-06	1.38E-03
tenbars1-ave	0.001	2.0	21.0	6.0	4.41E-05	2.71E-03
tenbars1-1	0.01	2	21	7	1.16E-03	1.54E-02
tenbars1-2	0.01	2	21	7	2.48E-04	7.10E-03
tenbars1-3	0.01	3	21	6	1.47E-04	5.46E-03
tenbars1-4	0.01	1	21	6	5.57E-04	1.06E-02
tenbars1-5	0.01	2	21	6	9.22E-05	4.69E-03
tenbars1-ave	0.01	2.0	21.0	6.4	4.41E-04	8.66E-03

TABLE 15. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
tenbars2-1	0.0001	2	19	6	1.16E-05	1.54E-03
tenbars2-2	0.0001	2	19	6	2.48E-06	7.09E-04
tenbars2-3	0.0001	3	19	6	1.47E-06	5.46E-04
tenbars2-4	0.0001	1	19	6	5.56E-06	1.06E-03
tenbars2-5	0.0001	2	19	6	9.21E-07	4.33E-04
tenbars2-ave	0.0001	2.0	19.0	6.0	4.41E-06	8.58E-04
tenbars2-1	0.001	2	19	6	1.16E-04	4.86E-03
tenbars2-2	0.001	2	19	6	2.48E-05	2.24E-03
tenbars2-3	0.001	3	19	6	1.47E-05	1.73E-03
tenbars2-4	0.001	1	19	6	5.56E-05	3.36E-03
tenbars2-5	0.001	2	19	6	9.22E-06	1.38E-03
tenbars2-ave	0.001	2.0	19.0	6.0	4.41E-05	2.71E-03
tenbars2-1	0.01	2	19	6	1.16E-03	1.54E-02
tenbars2-2	0.01	2	19	6	2.48E-04	7.10E-03
tenbars2-3	0.01	3	19	6	1.47E-04	5.46E-03
tenbars2-4	0.01	1	19	6	5.57E-04	1.06E-02
tenbars2-5	0.01	2	19	6	9.22E-05	4.69E-03
tenbars2-ave	0.01	2.0	19.0	6.0	4.41E-04	8.66E-03
tenbars3-1	0.0001	2	20	8	1.24E-05	1.16E-02
tenbars3-2	0.0001	2	20	8	2.65E-06	5.35E-03
tenbars3-3	0.0001	3	20	8	1.54E-06	4.07E-03
tenbars3-4	0.0001	1	20	8	5.90E-06	7.98E-03
tenbars3-5	0.0001	2	20	8	2.40E-07	1.61E-03
tenbars3-ave	0.0001	2.0	20.0	8.0	4.54E-06	6.11E-03
tenbars3-1	0.001	2	20	8	1.24E-04	3.65E-02
tenbars3-2	0.001	2	20	8	2.64E-05	1.69E-02
tenbars3-3	0.001	3	20	8	1.53E-05	1.29E-02
tenbars3-4	0.001	1	20	8	5.90E-05	2.52E-02
tenbars3-5	0.001	2	20	8	2.50E-06	5.20E-03
tenbars3-ave	0.001	2.0	20.0	8.0	4.54E-05	1.93E-02
tenbars3-1	0.01	2	20	8	1.23E-03	1.15E-01
tenbars3-2	0.01	2	20	8	2.64E-04	5.34E-02
tenbars3-3	0.01	3	20	8	1.53E-04	4.06E-02
tenbars3-4	0.01	1	20	8	5.91E-04	7.99E-02
tenbars3-5	0.01	2	20	8	2.51E-05	1.65E-02
tenbars3-ave	0.01	2.0	20.0	8.0	4.53E-04	6.12E-02
tenbars4-1	0.0001	1	15	5	7.54E-07	4.95E-04
tenbars4-2	0.0001	2	15	5	1.55E-06	7.10E-04
tenbars4-3	0.0001	2	15	5	1.13E-05	1.91E-03
tenbars4-4	0.0001	1	15	5	8.06E-07	5.11E-04
tenbars4-5	0.0001	2	15	5	2.57E-06	9.14E-04
tenbars4-ave	0.0001	1.6	15.0	5.0	3.39E-06	9.08E-04
tenbars4-1	0.001	1	15	5	3.45E-06	1.06E-03
tenbars4-2	0.001	2	15	5	1.43E-05	2.15E-03
tenbars4-3	0.001	2	15	5	1.12E-04	6.03E-03
tenbars4-4	0.001	1	15	5	4.89E-06	1.26E-03
tenbars4-5	0.001	2	15	5	2.40E-05	2.79E-03
tenbars4-ave	0.001	1.6	15.0	5.0	3.17E-05	2.66E-03
tenbars4-1	0.01	1	15	5	3.51E-05	3.38E-03
tenbars4-2	0.01	2	15	5	1.43E-04	6.82E-03
tenbars4-3	0.01	2	15	5	1.11E-03	1.90E-02
tenbars4-4	0.01	1	15	5	4.98E-05	4.02E-03
tenbars4-5	0.01	2	15	5	2.39E-04	8.81E-03
tenbars4-ave	0.01	1.6	15.0	5.0	3.16E-04	8.42E-03

TABLE 16. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
truspyr1-1	0.0001	2	15	7	6.10E-03	8.70E-03
truspyr1-2	0.0001	2	15	7	6.82E-03	9.19E-03
truspyr1-3	0.0001	2	17	9	2.01E-01	4.99E-02
truspyr1-4	0.0001	1	15	7	5.17E-03	8.00E-03
truspyr1-5	0.0001	1	17	9	2.01E-01	5.00E-02
truspyr1-ave	0.0001	1.6	15.8	7.8	8.41E-02	2.52E-02
truspyr1-1	0.001	2	15	7	6.45E-03	8.94E-03
truspyr1-2	0.001	2	15	9	4.85E-02	2.45E-02
truspyr1-3	0.001	2	16	8	2.02E-01	5.00E-02
truspyr1-4	0.001	1	15	7	6.38E-03	8.89E-03
truspyr1-5	0.001	1	16	8	2.02E-01	5.00E-02
truspyr1-ave	0.001	1.6	15.4	7.8	9.29E-02	2.85E-02
truspyr1-1	0.01	2	15	7	7.49E-03	9.64E-03
truspyr1-2	0.01	2	15	7	8.78E-03	1.04E-02
truspyr1-3	0.01	2	16	7	2.04E-01	5.02E-02
truspyr1-4	0.01	1	15	7	6.40E-03	8.91E-03
truspyr1-5	0.01	1	16	8	2.02E-01	5.03E-02
truspyr1-ave	0.01	1.6	15.4	7.2	8.57E-02	2.59E-02
truspyr2-1	0.0001	2	15	7	1.88E-02	2.68E-01
truspyr2-2	0.0001	2	15	7	1.89E-02	2.68E-01
truspyr2-3	0.0001	2	17	9	7.27E-01	3.14E-01
truspyr2-4	0.0001	1	15	7	1.88E-02	2.68E-01
truspyr2-5	0.0001	1	17	9	7.27E-01	3.11E-01
truspyr2-ave	0.0001	1.6	15.8	7.8	3.02E-01	2.86E-01
truspyr2-1	0.001	2	15	7	1.88E-02	2.68E-01
truspyr2-2	0.001	2	15	7	1.86E-02	2.68E-01
truspyr2-3	0.001	2	17	8	7.27E-01	3.05E-01
truspyr2-4	0.001	1	15	7	1.88E-02	2.68E-01
truspyr2-5	0.001	1	17	8	7.27E-01	3.03E-01
truspyr2-ave	0.001	1.6	15.8	7.4	3.02E-01	2.82E-01
truspyr2-1	0.01	2	15	7	1.87E-02	2.68E-01
truspyr2-2	0.01	2	15	7	1.83E-02	2.68E-01
truspyr2-3	0.01	2	17	9	7.27E-01	3.20E-01
truspyr2-4	0.01	1	15	7	1.88E-02	2.68E-01
truspyr2-5	0.01	1	20	8	7.27E-01	3.01E-01
truspyr2-ave	0.01	1.6	16.4	7.6	3.02E-01	2.85E-01
ubh5-1	0.0001	11	7	2	7.73E-02	1.68E+00
ubh5-2	0.0001	21	7	2	1.06E-01	1.96E+00
ubh5-3	0.0001	19	7	2	2.18E-02	8.91E-01
ubh5-4	0.0001	14	7	2	6.55E-02	1.54E+00
ubh5-5	0.0001	24	7	2	5.04E-02	1.36E+00
ubh5-ave	0.0001	17.8	7.0	2.0	6.42E-02	1.49E+00
ubh5-1	0.001	11	7	4	7.75E-01	5.31E+00
ubh5-2	0.001	21	7	4	1.06E+00	6.22E+00
ubh5-3	0.001	19	7	3	2.19E-01	2.82E+00
ubh5-4	0.001	14	7	4	6.58E-01	4.90E+00
ubh5-5	0.001	24	7	3	5.06E-01	4.29E+00
ubh5-ave	0.001	17.8	7.0	3.6	6.44E-01	4.71E+00
ubh5-1	0.01	11	8	5	7.75E+00	1.68E+01
ubh5-2	0.01	21	9	5	1.06E+01	1.97E+01
ubh5-3	0.01	19	7	5	2.20E+00	8.95E+00
ubh5-4	0.01	14	8	6	6.60E+00	1.55E+01
ubh5-5	0.01	24	8	5	5.09E+00	1.36E+01
ubh5-ave	0.01	17.8	8.0	5.2	6.45E+00	1.49E+01

TABLE 17. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.

Problem	δ	#Pert	ColdIters	WarmIters	$\|x^I - x^P\|$	$\|y^I - y^P\|$
womflet-1	0.0001	1	24	5	4.36E-06	2.79E-03
womflet-2	0.0001	1	24	5	8.39E-08	3.87E-04
womflet-3	0.0001	1	24	5	8.39E-08	3.87E-04
womflet-4	0.0001	1	24	5	2.04E-06	1.91E-03
womflet-5	0.0001	1	24	5	4.66E-06	2.88E-03
womflet-ave	0.0001	1.0	24.0	5.0	2.24E-06	1.67E-03
womflet-1	0.001	1	24	5	4.36E-05	8.82E-03
womflet-2	0.001	1	24	5	8.39E-08	3.91E-04
womflet-3	0.001	1	25	5	8.39E-08	4.03E-04
womflet-4	0.001	1	24	5	1.97E-05	5.93E-03
womflet-5	0.001	1	24	5	4.59E-05	9.05E-03
womflet-ave	0.001	1.0	24.2	5.0	2.18E-05	4.92E-03
womflet-1	0.01	1	23	5	4.36E-04	2.79E-02
womflet-2	0.01	1	26	5	8.39E-08	6.73E-04
womflet-3	0.01	1	26	5	8.39E-08	1.18E-03
womflet-4	0.01	1	25	5	1.96E-04	1.87E-02
womflet-5	0.01	1	26	5	4.60E-04	2.87E-02
womflet-ave	0.01	1.0	25.2	5.0	2.18E-04	1.54E-02

TABLE 18. Numerical performance of LOQO on NLPs from the CUTEr test suite when warmstarting a problem whose objective function coefficients, c, have been modified. All problems considered have linear objective functions. Each problem is labeled under the column Problem, 5 instances of each problem are presented, "ave" refers to the average performance over the five problems, δ is the perturbation parameter, and #Pert is the number of perturbed coefficients. The iteration counts for the warmstart and coldstart solution of five perturbed problems are given, and the last 2 columns are the scaled Euclidean norm of the distance between the optimal solutions and the Lagrange multipliers of the initial and the perturbed problem.