Table 1: Comprehensive Performance Comparison of Optimization Algorithms

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
Sphere_2D	**Adam-Robust**	5.86e-2	2.41e-2	2.27e-2	1.25e-1	2502.0	0.0		
	Adam-AMSGrad	7.20e-2	3.21e-2	2.82e-2	1.30e-1	2502.0	0.0		
	Adam	7.60e-3	2.83e-3	4.96e-3	1.28e-2	2432.4	40.0		
	Adam-WeightDecay	4.98e-3	2.03e-5	4.94e-3	5.00e-3	1113.1	100.0		
	GD	4.93e-3	5.43e-5	4.81e-3	5.00e-3	152.6	100.0		
	Trust Region-Conservative	1.69e-3	1.41e-3	2.11e-4	4.46e-3	602.0	100.0		
	L-BFGS-Conservative	4.28e-3	6.13e-4	2.80e-3	4.97e-3	156.2	100.0		
	GD-WeightDecay	4.67e-3	1.71e-4	4.31e-3	4.95e-3	51.6	100.0		
	Trust Region-Precise	6.58e-1	7.91e-1	5.18e-6	2.79e0	115.3	55.0		
	Adam-Fast	8.78e-2	5.67e-2	2.82e-4	1.34e-1	33.5	30.0		
	GD-Momentum	4.85e-4	1.02e-3	1.93e-4	4.95e-3	16.9	100.0		
	GD-Nesterov	2.51e-3	2.02e-3	2.83e-4	4.93e-3	16.4	100.0		
	GD-AdaptiveMomentum	2.05e-1	2.50e-1	2.68e-5	5.53e-1	13.8	60.0		
	L-BFGS-Limited	1.24e-3	1.70e-3	0.00e0	4.92e-3	23.1	100.0		
	QQN-GoldenSection	3.22e-14	4.92e-15	2.46e-14	3.96e-14	46.0	100.0		
	Trust Region-Adaptive	6.68e2	6.05e2	1.21e-5	1.22e3	41.1	35.0		
	QQN-Bisection-2	0.00e0	0.00e0	0.00e0	0.00e0	13.0	100.0		
	Trust Region-Standard	1.25e3	2.01e3	7.55e-4	6.04e3	27.1	10.0		
	L-BFGS	8.79e-5	3.32e-4	0.00e0	1.51e-3	13.5	100.0		
	QQN-Bisection-1	0.00e0	0.00e0	0.00e0	0.00e0	15.0	100.0		
	Trust Region-Aggressive	7.95e3	5.21e3	2.26e-5	1.15e4	18.6	30.0		
	QQN-CubicQuadraticInterpolation	0.00e0	0.00e0	0.00e0	0.00e0	12.0	100.0		
	QQN-StrongWolfe	0.00e0	0.00e0	0.00e0	0.00e0	11.0	100.0		
	L-BFGS-MoreThuente	0.00e0	0.00e0	0.00e0	0.00e0	10.0	100.0		
	L-BFGS-Aggressive	0.00e0	0.00e0	0.00e0	0.00e0	10.0	100.0		
Sphere_10D	**Adam-Robust**	1.08e-1	3.40e-2	4.84e-2	1.71e-1	2502.0	0.0		
	Adam-AMSGrad	2.64e-1	4.59e-2	1.95e-1	3.63e-1	2502.0	0.0		
	Adam	4.98e-3	5.65e-5	4.94e-3	5.21e-3	2391.8	95.0		
	Adam-WeightDecay	4.92e-3	3.21e-5	4.88e-3	4.98e-3	968.0	100.0		
	Trust Region-Conservative	3.41e-1	3.63e-1	1.07e-3	1.34e0	2968.8	35.0		
	GD	4.91e-3	5.40e-5	4.82e-3	5.00e-3	192.4	100.0		
	L-BFGS-Conservative	4.51e-3	2.33e-4	4.20e-3	4.95e-3	197.5	100.0		
	Trust Region-Precise	5.27e-1	7.84e-1	1.01e-4	2.83e0	504.0	65.0		
	GD-WeightDecay	4.61e-3	1.67e-4	4.33e-3	4.92e-3	62.5	100.0		
	Trust Region-Adaptive	7.30e2	5.96e2	2.03e-4	1.22e3	139.3	30.0		
	Adam-Fast	6.12e-1	2.40e-2	5.73e-1	6.56e-1	37.4	0.0		
	L-BFGS-Limited	1.08e-3	1.10e-3	5.57e-7	4.03e-3	40.3	100.0		
	GD-AdaptiveMomentum	5.51e-1	6.74e-1	2.42e-4	1.41e0	18.4	60.0		
	GD-Nesterov	1.59e-1	2.14e-1	1.53e-5	4.62e-1	19.9	65.0		
	GD-Momentum	1.70e-1	2.92e-1	2.45e-5	7.34e-1	19.4	75.0		
	Trust Region-Standard	6.75e2	1.25e3	2.86e-5	6.06e3	51.8	15.0		
	QQN-GoldenSection	1.60e-13	1.03e-14	1.45e-13	1.79e-13	46.0	100.0		
	Trust Region-Aggressive	1.09e4	1.85e3	5.34e3	1.18e4	30.3	0.0		
	L-BFGS	0.00e0	0.00e0	0.00e0	0.00e0	15.0	100.0		
	QQN-Bisection-2	0.00e0	0.00e0	0.00e0	0.00e0	13.0	100.0		
	QQN-Bisection-1	0.00e0	0.00e0	0.00e0	0.00e0	15.0	100.0		
	QQN-CubicQuadraticInterpolation	0.00e0	0.00e0	0.00e0	0.00e0	12.0	100.0		
	QQN-StrongWolfe	0.00e0	0.00e0	0.00e0	0.00e0	11.0	100.0		
	L-BFGS-MoreThuente	0.00e0	0.00e0	0.00e0	0.00e0	10.0	100.0		
	L-BFGS-Aggressive	0.00e0	0.00e0	0.00e0	0.00e0	10.0	100.0		
Rosenbrock_2D	**QQN-GoldenSection**	1.26e-1	5.76e-2	8.08e-5	1.93e-1	4248.6	10.0		
	QQN-CubicQuadraticInterpolation	3.73e-2	3.12e-2	5.16e-3	9.89e-2	1619.8	40.0		
	QQN-StrongWolfe	5.67e-2	7.24e-2	4.58e-3	3.11e-1	2004.3	35.0		
	QQN-Bisection-1	4.65e-1	8.86e-1	6.39e-3	3.18e0	2363.3	5.0		
	Adam	1.22e0	3.51e-1	4.86e-1	1.76e0	2502.0	0.0		
	L-BFGS-Aggressive	3.18e1	2.86e1	4.34e0	1.12e2	3852.0	0.0		
	L-BFGS-Limited	3.93e0	5.18e0	3.26e-2	1.96e1	2251.6	0.0		
	GD	1.23e0	1.46e0	7.46e-1	6.37e0	854.0	0.0		
	Trust Region-Conservative	2.84e1	2.98e1	1.90e-1	1.23e2	2770.7	0.0		
	L-BFGS-Conservative	6.53e-3	2.16e-3	1.09e-3	8.39e-3	985.0	100.0		
	Adam-AMSGrad	3.83e0	1.33e0	4.66e-1	4.75e0	678.1	0.0		
	L-BFGS-MoreThuente	1.91e-2	6.42e-2	1.40e-4	2.99e-1	651.0	95.0		
	Adam-Robust	4.04e0	8.59e-1	1.90e0	4.73e0	419.2	0.0		
	QQN-Bisection-2	6.07e-2	6.89e-2	4.36e-3	2.52e-1	304.7	30.0		
	Trust Region-Precise	7.26e0	8.07e0	3.76e0	3.52e1	946.2	0.0		
	Adam-WeightDecay	4.11e0	9.66e-1	1.55e-2	4.69e0	231.9	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Adam-Fast	2.13e0	2.74e0	8.12e-3	8.39e0	171.8	60.0		
	Trust Region-Adaptive	4.12e0	2.07e-1	3.83e0	4.42e0	494.4	0.0		
	GD-WeightDecay	3.65e0	3.07e0	3.75e-2	1.07e1	58.7	0.0		
	L-BFGS	1.36e2	1.58e2	8.12e-1	5.03e2	121.5	0.0		
	GD-AdaptiveMomentum	6.54e-1	1.23e0	3.23e-3	4.36e0	47.7	25.0		
	GD-Nesterov	1.49e0	1.88e0	5.05e-2	5.63e0	46.1	0.0		
	GD-Momentum	5.61e0	3.44e0	4.79e-1	1.33e1	23.8	0.0		
	Trust Region-Standard	4.18e0	1.83e-1	3.95e0	4.51e0	89.6	0.0		
	Trust Region-Aggressive	4.66e0	3.99e-1	4.01e0	5.49e0	27.6	0.0		
Rosenbrock_5D	**QQN-GoldenSection**	6.13e-1	3.74e-1	2.60e-1	1.61e0	3314.1	55.0		
	Adam-Robust	1.46e1	6.99e0	6.12e0	2.99e1	2502.0	0.0		
	Adam-AMSGrad	4.40e0	3.25e-1	3.25e0	4.82e0	2442.0	0.0		
	Adam	3.92e0	4.66e-1	2.83e0	4.65e0	2471.6	0.0		
	QQN-CubicQuadraticInterpolation	4.25e-1	1.40e-1	2.38e-1	7.25e-1	1199.2	70.0		
	L-BFGS-Limited	4.21e-1	3.55e-2	3.92e-1	5.47e-1	3855.4	45.0		
	QQN-Bisection-2	4.48e-1	1.63e-1	2.15e-1	9.11e-1	1588.3	55.0		
	L-BFGS-Conservative	2.02e1	6.75e1	3.89e-1	3.11e2	3106.7	20.0		
	QQN-Bisection-1	6.94e-1	1.01e0	2.50e-1	4.64e0	1147.7	85.0		
	L-BFGS-Aggressive	8.07e2	4.06e2	1.72e1	1.19e3	3851.6	0.0		
	Adam-WeightDecay	2.07e0	2.05e0	3.93e-1	4.66e0	1128.9	60.0		
	QQN-StrongWolfe	3.45e-1	4.37e-2	2.58e-1	3.95e-1	792.6	100.0		
	Trust Region-Conservative	1.02e3	1.63e2	7.14e2	1.31e3	3002.0	0.0		
	Trust Region-Precise	1.01e3	1.27e2	8.08e2	1.35e3	3002.0	0.0		
	Trust Region-Adaptive	8.41e2	1.37e2	5.05e2	1.11e3	3002.0	0.0		
	L-BFGS-MoreThuente	9.01e-1	1.03e0	2.37e-1	3.50e0	1090.7	70.0		
	Trust Region-Standard	6.23e1	7.73e1	4.66e0	2.53e2	2827.2	0.0		
	GD-Nesterov	4.24e0	5.00e0	3.90e-1	1.31e1	335.4	10.0		
	Trust Region-Aggressive	5.00e0	4.17e-1	4.66e0	5.93e0	776.1	0.0		
	GD-WeightDecay	7.30e-1	1.08e0	3.59e-1	5.40e0	72.1	60.0		
	L-BFGS	1.50e2	2.28e2	1.98e1	7.52e2	135.3	0.0		
	Adam-Fast	1.44e1	3.86e0	3.48e-1	1.86e1	44.4	5.0		
	GD	5.09e0	1.48e-1	4.75e0	5.31e0	32.5	0.0		
	GD-AdaptiveMomentum	4.60e1	6.15e0	3.36e1	5.66e1	20.6	0.0		
	GD-Momentum	3.55e1	8.91e0	1.96e1	4.95e1	20.8	0.0		
Rosenbrock_10D	**Adam-Robust**	3.49e1	9.88e0	1.61e1	5.15e1	2502.0	0.0		
	Adam-AMSGrad	9.69e0	8.57e-3	9.66e0	9.70e0	2353.0	100.0		
	L-BFGS-Aggressive	1.64e2	3.20e2	5.82e1	1.56e3	3850.3	0.0		
	Adam	9.71e0	6.65e-2	9.68e0	9.93e0	2293.1	90.0		
	Trust Region-Conservative	2.16e3	2.33e2	1.76e3	2.55e3	3002.0	0.0		
	Trust Region-Standard	1.06e3	2.06e2	6.70e2	1.41e3	3002.0	0.0		
	Trust Region-Adaptive	2.02e3	2.22e2	1.64e3	2.59e3	3002.0	0.0		
	Trust Region-Precise	2.10e3	1.92e2	1.66e3	2.46e3	3002.0	0.0		
	Adam-WeightDecay	9.67e0	2.09e-2	9.61e0	9.70e0	789.4	100.0		
	Trust Region-Aggressive	1.00e1	3.85e-1	9.59e0	1.09e1	1615.8	30.0		
	L-BFGS-Conservative	9.68e0	1.80e-2	9.63e0	9.70e0	205.3	100.0		
	QQN-GoldenSection	9.45e0	1.57e-1	9.03e0	9.66e0	277.2	100.0		
	L-BFGS	1.19e2	1.68e2	2.51e1	7.37e2	338.9	0.0		
	QQN-CubicQuadraticInterpolation	9.60e0	5.83e-2	9.48e0	9.70e0	109.6	100.0		
	L-BFGS-MoreThuente	9.20e0	1.98e0	7.83e0	1.75e1	212.8	95.0		
	QQN-Bisection-1	8.47e0	8.02e-1	7.17e0	9.68e0	120.3	100.0		
	QQN-StrongWolfe	8.69e0	5.85e-1	7.76e0	9.57e0	90.3	100.0		
	QQN-Bisection-2	9.37e0	3.57e-1	8.02e0	9.67e0	83.2	100.0		
	Adam-Fast	1.94e1	1.08e1	9.18e0	3.68e1	61.6	45.0		
	GD-WeightDecay	9.58e0	5.37e-2	9.45e0	9.67e0	35.7	100.0		
	GD	9.75e0	2.14e-1	9.59e0	1.02e1	41.5	75.0		
	GD-Momentum	3.53e1	2.87e1	9.32e0	7.27e1	35.0	55.0		
	L-BFGS-Limited	9.59e0	4.89e-2	9.51e0	9.68e0	62.3	100.0		
	GD-Nesterov	9.31e0	1.92e-1	8.97e0	9.62e0	28.6	100.0		
	GD-AdaptiveMomentum	1.02e2	9.83e0	8.45e1	1.16e2	23.1	0.0		
Michalewicz_2D_m10	**QQN-Bisection-1**	-1.99e-2	8.69e-2	-3.99e-1	-1.17e-13	1278.7	0.0		
	Adam	-4.98e-1	4.98e-1	-9.97e-1	-2.05e-12	1642.0	50.0		
	QQN-StrongWolfe	-4.01e-2	1.75e-1	-8.01e-1	-8.45e-13	1192.1	0.0		
	QQN-GoldenSection	-7.52e-7	2.11e-6	-9.60e-6	-8.52e-13	1573.8	0.0		
	QQN-Bisection-2	-4.01e-2	1.75e-1	-8.01e-1	-4.27e-14	1074.5	0.0		
	Adam-Fast	-4.71e-1	4.78e-1	-1.00e0	-4.63e-13	1058.0	40.0		
	L-BFGS-Aggressive	-8.97e-2	2.69e-1	-8.97e-1	-2.07e-13	1145.5	0.0		
	L-BFGS-Conservative	-7.20e-7	2.35e-6	-1.07e-5	-2.95e-14	838.7	0.0		
	GD-WeightDecay	-3.24e-6	7.04e-6	-2.45e-5	-3.78e-13	423.0	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	L-BFGS	-9.99e-2	3.00e-1	-1.00e0	-4.83e-13	802.0	10.0		
	L-BFGS-MoreThuente	-2.50e-1	4.32e-1	-1.00e0	-4.09e-13	752.4	25.0		
	GD-Nesterov	-9.98e-2	2.99e-1	-9.99e-1	-3.87e-13	272.0	10.0		
	GD	-1.16e-6	2.04e-6	-7.38e-6	-3.67e-14	252.8	0.0		
	L-BFGS-Limited	-2.50e-1	4.32e-1	-1.00e0	-3.18e-14	466.0	25.0		
	Adam-AMSGrad	-2.99e-1	4.57e-1	-9.96e-1	-1.10e-12	192.4	30.0		
	GD-Momentum	-3.25e-2	1.42e-1	-6.49e-1	-6.08e-14	42.9	0.0		
	GD-AdaptiveMomentum	-5.00e-2	2.18e-1	-9.99e-1	-6.90e-14	29.5	5.0		
	QQN-CubicQuadraticInterpolation	-5.13e-7	2.19e-6	-1.00e-5	-4.20e-14	19.1	0.0		
	Adam-Robust	-3.65e-7	9.47e-7	-3.26e-6	-9.07e-14	13.0	0.0		
	Adam-WeightDecay	-3.49e-7	6.17e-7	-2.33e-6	-7.24e-14	13.0	0.0		
	Trust Region-Precise	-7.80e-7	1.28e-6	-4.71e-6	-4.65e-14	4.5	0.0		
	Trust Region-Adaptive	-4.40e-7	7.97e-7	-2.59e-6	-3.25e-14	4.3	0.0		
	Trust Region-Aggressive	-5.33e-7	1.94e-6	-8.89e-6	-6.50e-14	4.2	0.0		
	Trust Region-Conservative	-8.81e-7	3.16e-6	-1.46e-5	-1.54e-13	4.3	0.0		
	Trust Region-Standard	-6.09e-7	2.15e-6	-9.91e-6	-1.36e-13	4.2	0.0		
Michalewicz_5D_m10	**QQN-CubicQuadraticInterpolation**	-8.49e-1	4.86e-1	-1.88e0	-4.46e-5	1726.7	0.0		
	QQN-StrongWolfe	-1.76e0	7.40e-1	-2.79e0	-5.69e-5	1288.2	25.0		
	QQN-Bisection-1	-1.78e0	6.73e-1	-2.74e0	-8.39e-1	1432.2	20.0		
	QQN-GoldenSection	-1.36e0	7.15e-1	-2.69e0	-3.60e-6	1751.2	5.0		
	QQN-Bisection-2	-1.78e0	8.34e-1	-2.85e0	-2.09e-4	1315.8	35.0		
	L-BFGS-Conservative	-1.78e0	7.13e-1	-2.69e0	-8.39e-1	1302.2	30.0		
	L-BFGS-Aggressive	-4.98e-1	3.88e-1	-1.25e0	1.67e-8	3524.2	0.0		
	L-BFGS-Limited	-8.44e-1	6.65e-1	-1.86e0	-3.16e-6	2003.6	0.0		
	GD	-2.00e0	7.11e-1	-2.69e0	-8.39e-1	738.0	45.0		
	Adam-AMSGrad	-2.17e0	6.28e-1	-2.71e0	-8.39e-1	439.6	55.0		
	Adam	-2.46e0	5.04e-1	-2.71e0	-8.39e-1	474.6	80.0		
	L-BFGS-MoreThuente	-1.39e0	5.83e-1	-2.73e0	-8.39e-1	519.5	5.0		
	GD-Nesterov	-1.24e0	6.70e-1	-2.69e0	-6.95e-1	159.9	5.0		
	Adam-WeightDecay	-1.75e0	5.79e-1	-2.69e0	-8.31e-1	178.5	10.0		
	GD-WeightDecay	-1.24e0	5.21e-1	-2.69e0	-7.45e-1	86.0	5.0		
	Adam-Robust	-1.65e0	7.13e-1	-2.69e0	-8.20e-1	83.1	10.0		
	Trust Region-Conservative	-9.74e-1	4.08e-1	-1.86e0	-1.78e-3	263.6	0.0		
	GD-Momentum	-1.11e0	8.01e-1	-2.69e0	-4.00e-5	51.9	5.0		
	Adam-Fast	-2.62e0	4.21e-1	-3.29e0	-1.68e0	70.8	65.0		
	L-BFGS	-2.16e-1	2.92e-1	-8.96e-1	-1.24e-6	90.4	0.0		
	GD-AdaptiveMomentum	-1.09e0	5.78e-1	-2.69e0	-4.06e-1	27.8	5.0		
	Trust Region-Precise	-9.85e-1	6.29e-1	-1.74e0	-1.94e-6	41.0	0.0		
	Trust Region-Adaptive	-7.58e-1	6.00e-1	-1.73e0	-4.40e-4	10.8	0.0		
	Trust Region-Standard	-3.29e-1	4.87e-1	-1.53e0	-4.71e-5	5.5	0.0		
	Trust Region-Aggressive	-1.81e-1	2.12e-1	-7.69e-1	-2.00e-4	5.0	0.0		
Michalewicz_10D_m10	**QQN-CubicQuadraticInterpolation**	-3.34e0	1.51e0	-6.26e0	-9.35e-1	1730.8	0.0		
	QQN-StrongWolfe	-4.71e0	1.16e0	-6.27e0	-2.13e0	1916.5	5.0		
	QQN-Bisection-1	-4.24e0	1.09e0	-5.36e0	-2.14e0	2030.0	0.0		
	QQN-Bisection-2	-4.37e0	1.24e0	-6.26e0	-1.67e0	1808.5	5.0		
	QQN-GoldenSection	-4.14e0	1.08e0	-6.30e0	-2.32e0	2197.4	5.0		
	L-BFGS-Limited	-3.52e0	1.38e0	-5.59e0	-6.44e-1	3009.3	0.0		
	L-BFGS-Conservative	-4.54e0	9.46e-1	-6.26e0	-2.94e0	2566.8	0.0		
	L-BFGS-Aggressive	-1.30e0	9.34e-1	-3.26e0	3.39e-1	3050.9	0.0		
	L-BFGS-MoreThuente	-4.11e0	7.64e-1	-5.98e0	-2.73e0	925.2	0.0		
	Adam	-5.84e0	5.72e-1	-6.27e0	-4.65e0	508.9	20.0		
	Adam-AMSGrad	-5.74e0	6.30e-1	-6.28e0	-4.40e0	450.1	30.0		
	GD-WeightDecay	-4.56e0	7.54e-1	-6.26e0	-2.97e0	174.7	0.0		
	Trust Region-Conservative	-3.71e0	9.15e-1	-5.42e0	-2.14e0	644.0	0.0		
	Adam-WeightDecay	-5.31e0	5.80e-1	-6.25e0	-4.38e0	179.3	0.0		
	Adam-Robust	-5.03e0	7.58e-1	-6.26e0	-3.55e0	111.0	0.0		
	Adam-Fast	-6.12e0	4.94e-1	-6.77e0	-4.58e0	106.2	35.0		
	GD-Momentum	-3.79e0	1.08e0	-5.24e0	-1.13e0	37.3	0.0		
	GD-AdaptiveMomentum	-4.52e0	7.73e-1	-6.23e0	-2.85e0	27.6	0.0		
	L-BFGS	-3.66e-1	3.76e-1	-1.14e0	6.67e-2	64.8	0.0		
	Trust Region-Precise	-3.69e0	9.58e-1	-5.30e0	-2.10e0	114.2	0.0		
	GD-Nesterov	-3.74e0	1.19e0	-6.19e0	-1.81e0	26.9	0.0		
	GD	-3.59e0	7.26e-1	-5.04e0	-2.59e0	17.2	0.0		
	Trust Region-Adaptive	-3.26e0	9.04e-1	-5.27e0	-1.43e0	28.7	0.0		
	Trust Region-Standard	-2.49e0	1.15e0	-4.98e0	-5.97e-1	9.8	0.0		
	Trust Region-Aggressive	-1.68e0	6.53e-1	-3.16e0	-5.90e-1	5.3	0.0		
Rastrigin_2D	**L-BFGS-Aggressive**	2.81e1	4.88e0	1.91e1	3.73e1	3851.8	0.0		
	Trust Region-Conservative	1.85e1	4.65e0	9.36e0	2.65e1	3002.0	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Adam-AMSGrad	1.02e1	2.48e0	7.96e0	1.29e1	770.2	55.0		
	Adam	1.02e1	2.48e0	7.96e0	1.29e1	780.5	55.0		
	L-BFGS-Conservative	9.82e0	5.01e0	7.96e0	3.02e1	455.9	75.0		
	Trust Region-Precise	9.71e0	2.37e0	7.96e0	1.29e1	915.9	10.0		
	Adam-WeightDecay	9.71e0	2.38e0	7.96e0	1.30e1	254.7	50.0		
	L-BFGS-MoreThuente	8.56e0	5.94e0	1.83e0	3.12e1	170.8	55.0		
	Adam-Robust	9.22e0	2.16e0	7.96e0	1.30e1	111.5	15.0		
	QQN-Bisection-1	8.59e0	4.47e0	1.03e0	1.69e1	125.3	65.0		
	QQN-GoldenSection	8.19e0	5.01e0	1.29e-1	1.79e1	156.0	55.0		
	QQN-CubicQuadraticInterpolation	7.75e0	3.18e0	2.17e0	1.59e1	64.2	80.0		
	Trust Region-Adaptive	9.68e0	3.46e0	7.96e0	2.21e1	241.0	15.0		
	QQN-StrongWolfe	8.32e0	4.20e0	1.36e0	1.69e1	71.4	65.0		
	L-BFGS-Limited	9.13e0	2.25e0	5.86e0	1.29e1	106.5	70.0		
	L-BFGS	5.70e1	3.05e1	2.49e0	1.31e2	88.4	5.0		
	GD-WeightDecay	1.01e1	2.27e0	7.96e0	1.34e1	24.3	5.0		
	Adam-Fast	9.46e0	2.04e0	8.02e0	1.43e1	36.3	0.0		
	GD-AdaptiveMomentum	8.98e0	1.78e0	7.97e0	1.34e1	21.5	0.0		
	GD-Momentum	1.04e1	2.44e0	7.98e0	1.57e1	22.7	0.0		
	GD-Nesterov	1.00e1	2.35e0	7.96e0	1.37e1	20.1	5.0		
	QQN-Bisection-2	8.57e0	4.87e0	2.07e0	1.69e1	23.8	30.0		
	Trust Region-Standard	9.02e0	1.98e0	7.96e0	1.30e1	63.8	0.0		
	GD	1.04e1	2.51e0	7.96e0	1.40e1	13.3	5.0		
	Trust Region-Aggressive	1.29e1	8.89e0	7.97e0	3.74e1	20.1	0.0		
Rastrigin_5D	**L-BFGS-Aggressive**	7.97e1	9.04e0	5.68e1	9.50e1	3852.0	0.0		
	Trust Region-Conservative	6.91e1	7.96e0	5.03e1	8.29e1	3002.0	0.0		
	Adam-AMSGrad	2.38e1	3.35e0	2.04e1	2.99e1	719.2	40.0		
	Adam	2.42e1	3.17e0	2.03e1	2.99e1	745.3	30.0		
	Trust Region-Precise	2.39e1	3.48e0	2.03e1	2.99e1	2558.8	35.0		
	L-BFGS-Conservative	2.34e1	3.92e0	1.99e1	3.61e1	881.9	40.0		
	Adam-WeightDecay	2.27e1	3.13e0	2.02e1	2.99e1	246.9	55.0		
	Trust Region-Adaptive	2.34e1	5.02e0	2.02e1	4.05e1	646.1	60.0		
	QQN-GoldenSection	2.31e1	9.30e0	7.97e0	4.97e1	266.0	35.0		
	QQN-Bisection-1	2.48e1	4.08e0	1.80e1	3.38e1	186.6	25.0		
	QQN-CubicQuadraticInterpolation	2.30e1	8.41e0	4.91e0	4.28e1	106.2	50.0		
	L-BFGS-MoreThuente	2.77e1	2.23e1	7.71e0	9.40e1	165.1	50.0		
	QQN-StrongWolfe	2.36e1	5.65e0	1.16e1	4.08e1	100.2	40.0		
	Adam-Robust	2.24e1	3.09e0	1.99e1	2.99e1	103.5	55.0		
	GD-AdaptiveMomentum	2.14e1	2.74e0	1.83e1	2.99e1	52.4	65.0		
	GD-WeightDecay	2.25e1	2.90e0	1.89e1	2.99e1	37.8	50.0		
	L-BFGS-Limited	2.84e1	1.49e1	1.70e1	6.88e1	115.2	35.0		
	L-BFGS	1.02e2	2.33e1	5.89e1	1.42e2	98.2	0.0		
	Adam-Fast	2.33e1	3.56e0	1.92e1	3.17e1	48.9	40.0		
	GD-Nesterov	2.37e1	4.00e0	1.99e1	3.05e1	41.2	45.0		
	Trust Region-Standard	2.31e1	3.22e0	1.95e1	2.99e1	168.5	45.0		
	GD-Momentum	3.03e1	6.57e0	2.04e1	4.94e1	28.9	5.0		
	QQN-Bisection-2	3.08e1	1.62e1	1.10e1	6.07e1	36.6	15.0		
	GD	2.44e1	3.48e0	1.99e1	3.05e1	15.7	30.0		
	Trust Region-Aggressive	2.33e1	5.41e0	1.82e1	4.25e1	45.7	50.0		
Rastrigin_10D	**L-BFGS-Aggressive**	1.63e2	1.31e1	1.40e2	1.87e2	3852.0	0.0		
	Trust Region-Precise	9.70e1	1.03e1	6.33e1	1.13e2	3002.0	0.0		
	Trust Region-Conservative	1.57e2	1.05e1	1.28e2	1.71e2	3002.0	0.0		
	L-BFGS-Conservative	4.68e1	8.45e0	4.06e1	7.77e1	2037.2	20.0		
	Adam-AMSGrad	4.48e1	4.03e0	4.17e1	5.47e1	718.0	55.0		
	Adam	4.65e1	4.42e0	4.16e1	5.97e1	731.5	30.0		
	Trust Region-Adaptive	4.39e1	2.92e0	4.16e1	4.98e1	1397.8	40.0		
	GD-Nesterov	4.50e1	4.13e0	4.02e1	5.49e1	249.0	25.0		
	Adam-WeightDecay	4.52e1	3.97e0	4.15e1	5.48e1	253.8	35.0		
	L-BFGS-MoreThuente	4.11e1	7.33e0	2.56e1	6.07e1	291.6	65.0		
	QQN-Bisection-1	5.11e1	1.61e1	3.88e1	8.86e1	216.4	45.0		
	QQN-GoldenSection	4.53e1	1.18e1	2.11e1	7.26e1	275.4	50.0		
	QQN-StrongWolfe	5.16e1	1.59e1	3.24e1	9.55e1	118.5	40.0		
	QQN-CubicQuadraticInterpolation	4.52e1	7.84e0	3.21e1	5.87e1	102.5	60.0		
	Adam-Robust	4.44e1	4.07e0	4.13e1	5.48e1	127.9	30.0		
	Trust Region-Standard	4.59e1	6.59e0	4.10e1	7.11e1	346.6	25.0		
	GD-WeightDecay	4.39e1	3.41e0	3.60e1	4.98e1	61.3	45.0		
	Adam-Fast	4.51e1	4.26e0	3.98e1	5.44e1	71.9	30.0		
	L-BFGS-Limited	4.36e1	4.97e0	3.39e1	5.47e1	122.0	50.0		
	L-BFGS	1.85e2	3.27e1	1.42e2	2.59e2	102.0	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	QQN-Bisection-2	5.38e1	1.81e1	2.52e1	8.86e1	50.6	15.0		
	GD-Momentum	6.15e1	1.25e1	4.06e1	8.46e1	30.6	10.0		
	GD-AdaptiveMomentum	4.85e1	8.54e0	3.80e1	6.99e1	23.2	40.0		
	Trust Region-Aggressive	4.36e1	3.69e0	3.87e1	5.26e1	93.5	45.0		
	GD	4.47e1	4.34e0	3.89e1	5.49e1	19.4	35.0		
Ackley_2D_a20_b0.2_c6.28e0	**L-BFGS-Aggressive**	3.74e0	3.90e-1	2.80e0	4.38e0	3083.9	20.0		
	Adam-AMSGrad	3.57e0	2.23e-5	3.57e0	3.57e0	753.0	0.0		
	QQN-CubicQuadraticInterpolation	3.44e0	4.86e-1	1.95e0	4.24e0	496.8	40.0		
	Adam	3.57e0	5.40e-5	3.57e0	3.57e0	301.6	0.0		
	L-BFGS-Conservative	3.57e0	1.87e-8	3.57e0	3.57e0	183.6	0.0		
	L-BFGS	3.20e0	4.86e-1	1.89e0	3.57e0	202.7	50.0		
	Adam-WeightDecay	3.58e0	8.83e-4	3.57e0	3.58e0	119.4	0.0		
	L-BFGS-Limited	3.37e0	7.29e-1	2.64e-1	3.57e0	176.7	15.0		
	QQN-GoldenSection	3.18e0	6.29e-1	1.58e0	3.57e0	137.5	35.0		
	GD-WeightDecay	3.59e0	2.07e-2	3.57e0	3.66e0	49.2	0.0		
	QQN-StrongWolfe	3.49e0	1.92e-1	3.00e0	3.57e0	62.8	15.0		
	Trust Region-Conservative	3.58e0	1.90e-2	3.57e0	3.64e0	171.2	0.0		
	Adam-Fast	3.62e0	6.41e-2	3.57e0	3.79e0	52.9	0.0		
	Adam-Robust	3.58e0	3.34e-3	3.57e0	3.59e0	42.9	0.0		
	QQN-Bisection-1	2.85e0	1.05e0	1.12e-2	3.57e0	53.6	60.0		
	GD-Nesterov	3.57e0	2.11e-3	3.57e0	3.58e0	30.6	0.0		
	QQN-Bisection-2	2.75e0	1.16e0	3.79e-1	3.57e0	36.5	40.0		
	GD	3.57e0	1.91e-11	3.57e0	3.57e0	20.2	0.0		
	L-BFGS-MoreThuente	3.34e0	4.09e-1	1.83e0	3.57e0	42.2	45.0		
	GD-AdaptiveMomentum	3.57e0	6.21e-11	3.57e0	3.57e0	15.2	0.0		
	GD-Momentum	3.70e0	6.22e-2	3.57e0	3.79e0	14.7	0.0		
	Trust Region-Precise	3.58e0	1.39e-2	3.58e0	3.64e0	39.5	0.0		
	Trust Region-Adaptive	3.66e0	2.13e-1	3.32e0	4.52e0	14.8	5.0		
	Trust Region-Standard	5.19e0	3.91e0	3.58e0	1.70e1	8.6	0.0		
	Trust Region-Aggressive	4.78e0	2.77e0	3.62e0	1.67e1	5.3	0.0		
Ackley_5D_a20_b0.2_c6.28e0	**Adam-AMSGrad**	3.57e0	2.74e-9	3.57e0	3.57e0	1172.5	0.0		
	L-BFGS-Aggressive	3.76e0	2.74e-1	3.01e0	4.09e0	3085.2	20.0		
	Adam	3.57e0	1.27e-6	3.57e0	3.57e0	548.5	0.0		
	L-BFGS-Conservative	3.57e0	5.12e-8	3.57e0	3.57e0	373.8	0.0		
	QQN-CubicQuadraticInterpolation	3.56e0	9.71e-2	3.14e0	3.63e0	206.9	5.0		
	L-BFGS-Limited	3.57e0	1.20e-8	3.57e0	3.57e0	310.5	0.0		
	Adam-WeightDecay	3.57e0	4.57e-4	3.57e0	3.58e0	183.0	0.0		
	QQN-GoldenSection	3.51e0	2.78e-1	2.30e0	3.57e0	193.7	5.0		
	L-BFGS	3.46e0	4.50e-1	1.87e0	4.43e0	121.3	25.0		
	Adam-Fast	3.60e0	4.00e-2	3.57e0	3.73e0	83.3	0.0		
	Trust Region-Conservative	3.58e0	8.66e-4	3.57e0	3.58e0	212.3	0.0		
	Adam-Robust	3.58e0	3.67e-3	3.57e0	3.59e0	59.0	0.0		
	QQN-Bisection-1	3.38e0	3.60e-1	2.37e0	3.57e0	65.2	30.0		
	GD	3.57e0	2.52e-11	3.57e0	3.57e0	51.8	0.0		
	GD-AdaptiveMomentum	3.58e0	3.63e-3	3.57e0	3.59e0	34.5	0.0		
	QQN-StrongWolfe	3.50e0	3.36e-1	2.03e0	3.57e0	53.0	5.0		
	QQN-Bisection-2	3.34e0	3.86e-1	2.48e0	3.57e0	50.8	35.0		
	L-BFGS-MoreThuente	3.50e0	2.48e-1	2.54e0	3.57e0	51.0	10.0		
	GD-Nesterov	3.60e0	4.12e-2	3.57e0	3.76e0	17.0	0.0		
	GD-WeightDecay	3.61e0	2.38e-2	3.58e0	3.69e0	15.3	0.0		
	Trust Region-Precise	3.62e0	1.68e-1	3.57e0	4.35e0	45.5	0.0		
	GD-Momentum	3.72e0	1.33e-1	3.59e0	4.11e0	13.0	0.0		
	Trust Region-Adaptive	3.70e0	1.47e-1	3.58e0	4.11e0	17.3	0.0		
	Trust Region-Standard	4.49e0	1.26e0	3.60e0	6.86e0	9.1	0.0		
	Trust Region-Aggressive	4.15e0	2.82e-1	3.71e0	4.90e0	5.0	0.0		
Ackley_10D_a20_b0.2_c6.28e0	**Adam-AMSGrad**	3.57e0	2.45e-9	3.57e0	3.57e0	1241.4	0.0		
	Adam	3.57e0	7.49e-9	3.57e0	3.57e0	745.8	0.0		
	QQN-CubicQuadraticInterpolation	3.59e0	9.76e-2	3.33e0	3.84e0	471.4	5.0		
	Adam-WeightDecay	3.57e0	1.60e-5	3.57e0	3.57e0	281.3	0.0		
	L-BFGS-Conservative	3.57e0	5.16e-9	3.57e0	3.57e0	170.7	0.0		
	Adam-Robust	3.58e0	3.01e-3	3.57e0	3.59e0	126.8	0.0		
	QQN-GoldenSection	3.57e0	1.01e-8	3.57e0	3.57e0	186.9	0.0		
	GD	3.57e0	1.76e-10	3.57e0	3.57e0	99.3	0.0		
	L-BFGS-Aggressive	3.54e0	1.35e-1	2.95e0	3.57e0	185.8	5.0		
	L-BFGS-Limited	3.57e0	4.05e-10	3.57e0	3.57e0	142.2	0.0		
	Adam-Fast	3.60e0	4.10e-2	3.57e0	3.70e0	106.6	0.0		
	L-BFGS	3.50e0	2.17e-1	2.72e0	3.58e0	133.3	15.0		
	QQN-StrongWolfe	3.57e0	5.84e-15	3.57e0	3.57e0	79.2	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	QQN-Bisection-1	3.54e0	1.23e-1	3.08e0	3.57e0	96.2	10.0		
	Trust Region-Conservative	3.58e0	2.44e-3	3.57e0	3.58e0	205.8	0.0		
	QQN-Bisection-2	3.54e0	7.29e-2	3.30e0	3.57e0	65.9	20.0		
	L-BFGS-MoreThuente	3.57e0	1.12e-2	3.52e0	3.57e0	55.9	5.0		
	GD-WeightDecay	3.59e0	6.14e-3	3.58e0	3.60e0	19.4	0.0		
	GD-AdaptiveMomentum	3.60e0	1.35e-2	3.57e0	3.63e0	16.1	0.0		
	GD-Nesterov	3.66e0	2.68e-2	3.62e0	3.72e0	14.0	0.0		
	Trust Region-Precise	3.61e0	7.74e-2	3.58e0	3.92e0	42.5	0.0		
	GD-Momentum	3.81e0	6.88e-2	3.64e0	3.91e0	14.5	0.0		
	Trust Region-Adaptive	4.41e0	1.08e0	3.59e0	6.23e0	18.2	0.0		
	Trust Region-Aggressive	4.22e0	2.38e-1	3.81e0	4.95e0	5.2	0.0		
	Trust Region-Standard	4.36e0	8.00e-1	3.64e0	5.79e0	9.1	0.0		
StyblinskiTang_2D	**Adam-AMSGrad**	-3.03e1	1.58e0	-3.29e1	-2.78e1	2502.0	0.0		
	Adam-Robust	-2.07e1	2.26e0	-2.44e1	-1.49e1	2502.0	0.0		
	Adam	-2.94e1	2.68e0	-3.47e1	-2.46e1	2502.0	0.0		
	Adam-WeightDecay	-7.55e1	5.64e0	-7.83e1	-6.42e1	1893.5	80.0		
	L-BFGS-Aggressive	-5.13e1	1.89e1	-7.77e1	-4.63e0	3848.1	0.0		
	Trust Region-Conservative	-1.02e1	4.38e-1	-1.15e1	-9.64e0	3002.0	0.0		
	Trust Region-Precise	-6.26e1	4.27e-1	-6.35e1	-6.22e1	3002.0	0.0		
	QQN-StrongWolfe	-7.34e1	6.74e0	-7.83e1	-6.42e1	284.4	65.0		
	L-BFGS-Conservative	-7.69e1	4.23e0	-7.83e1	-6.42e1	300.1	90.0		
	QQN-Bisection-1	-7.40e1	7.84e0	-7.83e1	-5.01e1	385.6	70.0		
	L-BFGS-Limited	-7.41e1	6.48e0	-7.83e1	-6.42e1	500.0	70.0		
	Trust Region-Adaptive	-7.37e1	1.73e1	-7.83e1	3.85e-1	885.1	70.0		
	QQN-GoldenSection	-7.69e1	4.24e0	-7.83e1	-6.42e1	159.8	90.0		
	QQN-CubicQuadraticInterpolation	-7.34e1	8.08e0	-7.83e1	-5.01e1	74.5	70.0		
	QQN-Bisection-2	-7.48e1	6.12e0	-7.83e1	-6.42e1	99.0	75.0		
	L-BFGS	-7.32e1	7.01e0	-7.83e1	-5.78e1	132.3	50.0		
	GD	-7.34e1	6.73e0	-7.83e1	-6.42e1	66.5	65.0		
	Adam-Fast	-7.48e1	4.67e0	-7.83e1	-6.16e1	67.3	35.0		
	Trust Region-Standard	6.01e1	5.78e2	-7.83e1	2.58e3	212.3	40.0		
	GD-WeightDecay	-7.46e1	6.18e0	-7.83e1	-6.37e1	39.9	35.0		
	GD-Momentum	-5.68e1	1.59e1	-7.83e1	-2.48e1	35.9	15.0		
	GD-Nesterov	-6.56e1	1.28e1	-7.83e1	-3.59e1	29.1	10.0		
	L-BFGS-MoreThuente	-7.41e1	6.47e0	-7.83e1	-6.42e1	54.1	70.0		
	GD-AdaptiveMomentum	-3.87e1	1.37e1	-7.83e1	-1.65e1	24.4	5.0		
	Trust Region-Aggressive	-6.43e1	2.56e1	-7.83e1	3.64e-1	49.3	20.0		
StyblinskiTang_5D	**Adam-AMSGrad**	-7.50e1	4.47e0	-8.10e1	-6.56e1	2502.0	0.0		
	Adam-Robust	-5.32e1	3.79e0	-6.12e1	-4.49e1	2502.0	0.0		
	Adam	-7.38e1	4.48e0	-8.30e1	-6.64e1	2502.0	0.0		
	Adam-WeightDecay	-1.90e2	6.36e0	-1.95e2	-1.82e2	1865.5	65.0		
	L-BFGS-Aggressive	-1.04e2	4.24e1	-1.83e2	-1.25e1	3847.9	0.0		
	Trust Region-Precise	-6.28e1	7.02e-1	-6.40e1	-6.17e1	3002.0	0.0		
	Trust Region-Conservative	-1.05e1	7.12e-1	-1.22e1	-9.39e0	3002.0	0.0		
	Trust Region-Adaptive	-1.88e2	1.11e1	-1.95e2	-1.67e2	2249.5	65.0		
	L-BFGS-Conservative	-1.89e2	1.03e1	-1.95e2	-1.59e2	567.8	65.0		
	L-BFGS-Limited	-1.89e2	6.97e0	-1.96e2	-1.82e2	839.9	50.0		
	QQN-Bisection-1	-1.89e2	8.22e0	-1.96e2	-1.68e2	413.4	60.0		
	QQN-StrongWolfe	-1.85e2	1.08e1	-1.96e2	-1.53e2	261.1	40.0		
	QQN-GoldenSection	-1.90e2	9.30e0	-1.96e2	-1.68e2	330.5	70.0		
	QQN-CubicQuadraticInterpolation	-1.82e2	1.48e1	-1.96e2	-1.53e2	129.7	45.0		
	QQN-Bisection-2	-1.89e2	9.39e0	-1.96e2	-1.68e2	177.8	60.0		
	L-BFGS-MoreThuente	-1.89e2	6.99e0	-1.96e2	-1.82e2	209.2	50.0		
	Trust Region-Standard	-1.88e2	8.33e0	-1.96e2	-1.67e2	568.8	55.0		
	GD	-1.86e2	1.17e1	-1.95e2	-1.53e2	95.7	50.0		
	L-BFGS	-1.86e2	7.77e0	-1.96e2	-1.74e2	153.3	30.0		
	GD-WeightDecay	-1.88e2	1.04e1	-1.96e2	-1.53e2	53.1	60.0		
	GD-Momentum	-1.64e2	3.72e1	-1.95e2	-7.54e1	57.8	15.0		
	GD-Nesterov	-1.82e2	1.85e1	-1.96e2	-1.16e2	44.9	30.0		
	Adam-Fast	-1.86e2	1.14e1	-1.96e2	-1.62e2	65.0	55.0		
	GD-AdaptiveMomentum	-1.35e2	3.62e1	-1.95e2	-7.45e1	34.4	10.0		
	Trust Region-Aggressive	-1.90e2	1.11e1	-1.96e2	-1.53e2	144.5	45.0		
StyblinskiTang_10D	**Adam-Robust**	-1.05e2	5.69e0	-1.13e2	-9.23e1	2502.0	0.0		
	Adam-AMSGrad	-1.51e2	6.41e0	-1.63e2	-1.38e2	2502.0	0.0		
	Adam	-1.49e2	8.21e0	-1.65e2	-1.36e2	2502.0	0.0		
	Adam-WeightDecay	-3.73e2	6.63e0	-3.78e2	-3.63e2	1837.7	35.0		
	L-BFGS-Aggressive	-1.97e2	5.94e1	-3.07e2	-3.33e1	3848.4	0.0		
	Trust Region-Precise	-6.35e1	9.97e-1	-6.56e1	-6.19e1	3002.0	0.0		

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Trust Region-Conservative	-1.09e1	7.10e-1	-1.25e1	-9.28e0	3002.0	0.0		
	Trust Region-Adaptive	-2.51e2	1.09e0	-2.54e2	-2.49e2	3002.0	0.0		
	QQN-Bisection-1	-3.74e2	9.58e0	-3.89e2	-3.49e2	412.5	30.0		
	L-BFGS-Conservative	-3.74e2	8.27e0	-3.82e2	-3.49e2	543.3	30.0		
	QQN-GoldenSection	-3.76e2	1.20e1	-3.91e2	-3.49e2	452.4	45.0		
	QQN-StrongWolfe	-3.60e2	1.80e1	-3.86e2	-3.21e2	362.2	15.0		
	L-BFGS-Limited	-3.76e2	7.70e0	-3.86e2	-3.63e2	550.6	35.0		
	Trust Region-Standard	-3.68e2	1.96e1	-3.79e2	-3.00e2	1120.5	40.0		
	QQN-CubicQuadraticInterpolation	-3.66e2	1.97e1	-3.91e2	-3.21e2	172.1	15.0		
	QQN-Bisection-2	-3.72e2	1.22e1	-3.90e2	-3.49e2	234.2	35.0		
	GD	-3.71e2	9.86e0	-3.80e2	-3.49e2	137.3	25.0		
	GD-Momentum	-3.59e2	3.83e1	-3.82e2	-1.98e2	86.2	15.0		
	GD-WeightDecay	-3.75e2	9.86e0	-3.83e2	-3.49e2	74.7	45.0		
	L-BFGS-MoreThuente	-3.76e2	1.18e1	-3.91e2	-3.49e2	125.9	35.0		
	GD-Nesterov	-3.75e2	7.32e0	-3.83e2	-3.60e2	65.9	30.0		
	L-BFGS	-3.76e2	1.21e1	-3.90e2	-3.46e2	132.2	45.0		
	Trust Region-Aggressive	-3.71e2	1.92e1	-3.81e2	-3.13e2	284.1	50.0		
	GD-AdaptiveMomentum	-3.21e2	6.46e1	-3.82e2	-1.87e2	53.4	20.0		
	Adam-Fast	-3.65e2	1.28e1	-3.85e2	-3.50e2	67.5	30.0		
Beale_2D	**Adam-AMSGrad**	2.17e-1	7.60e-2	8.70e-2	3.95e-1	2502.0	0.0		
	Adam-Robust	4.58e-1	2.48e-1	1.68e-1	1.07e0	2502.0	0.0		
	Adam	7.19e-2	3.00e-2	3.04e-2	1.57e-1	2502.0	0.0		
	Adam-WeightDecay	1.50e-2	2.32e-5	1.49e-2	1.50e-2	1539.9	100.0		
	QQN-StrongWolfe	4.59e-1	1.93e0	3.96e-3	8.88e0	786.0	90.0		
	L-BFGS-Aggressive	1.39e1	3.00e0	8.86e0	2.02e1	3851.9	0.0		
	Trust Region-Conservative	4.33e0	3.19e0	9.92e-3	1.29e1	2999.7	5.0		
	QQN-CubicQuadraticInterpolation	4.97e-1	2.13e0	2.46e-3	9.79e0	218.8	95.0		
	QQN-Bisection-1	4.13e-1	1.77e0	4.49e-3	8.13e0	277.4	95.0		
	GD	1.49e-2	4.62e-5	1.49e-2	1.50e-2	229.2	100.0		
	QQN-GoldenSection	6.90e-3	2.42e-3	2.42e-3	9.87e-3	347.2	100.0		
	L-BFGS-Conservative	1.17e-2	2.95e-3	5.27e-3	1.49e-2	200.7	100.0		
	Trust Region-Precise	2.17e-2	1.24e-2	3.20e-3	4.17e-2	743.8	45.0		
	GD-WeightDecay	1.48e-2	1.25e-4	1.46e-2	1.49e-2	88.0	100.0		
	QQN-Bisection-2	2.61e0	3.98e0	3.70e-3	9.20e0	83.8	70.0		
	L-BFGS	4.55e-1	8.11e-1	1.99e-3	3.15e0	122.0	65.0		
	L-BFGS-Limited	1.00e-2	4.71e-3	3.68e-4	1.49e-2	110.5	100.0		
	L-BFGS-MoreThuente	8.71e-3	4.80e-3	3.68e-4	1.50e-2	78.1	100.0		
	Trust Region-Adaptive	1.27e-1	1.01e-1	3.79e-2	5.20e-1	179.6	0.0		
	GD-AdaptiveMomentum	3.09e-1	7.01e-1	6.42e-4	2.11e0	25.5	80.0		
	GD-Nesterov	9.18e-3	2.78e-3	4.69e-3	1.44e-2	27.7	100.0		
	Adam-Fast	1.59e0	1.58e-1	1.39e0	1.86e0	37.6	0.0		
	GD-Momentum	1.32e0	9.54e-1	1.20e-2	2.68e0	24.4	5.0		
	Trust Region-Standard	2.71e2	1.18e3	1.24e-1	5.41e3	50.2	0.0		
	Trust Region-Aggressive	1.23e0	4.13e-1	1.33e-3	1.91e0	17.8	5.0		
Levi_2D	**L-BFGS-Aggressive**	2.87e0	8.03e-1	1.00e0	4.17e0	3851.3	0.0		
	QQN-StrongWolfe	1.44e0	9.74e-1	1.40e-1	3.07e0	450.4	25.0		
	L-BFGS-Limited	9.89e-1	6.68e-1	1.13e-1	2.50e0	828.4	25.0		
	QQN-CubicQuadraticInterpolation	1.04e0	8.94e-1	1.50e-1	2.75e0	189.6	40.0		
	Adam-AMSGrad	1.91e0	1.49e-1	1.43e0	1.98e0	282.9	0.0		
	Adam	1.93e0	1.42e-1	1.43e0	1.98e0	242.4	0.0		
	QQN-GoldenSection	9.83e-1	8.11e-1	1.87e-2	1.98e0	262.0	45.0		
	QQN-Bisection-1	1.30e0	7.24e-1	1.54e-1	2.44e0	200.7	15.0		
	L-BFGS-Conservative	1.94e0	1.32e-1	1.43e0	1.98e0	209.4	0.0		
	Trust Region-Conservative	1.95e0	3.47e-1	1.07e0	2.75e0	490.0	0.0		
	Adam-WeightDecay	1.95e0	2.71e-1	1.44e0	2.76e0	99.6	0.0		
	L-BFGS	4.40e0	4.35e0	1.84e-1	1.60e1	107.2	15.0		
	L-BFGS-MoreThuente	1.48e0	6.68e-1	1.36e-1	1.98e0	86.2	15.0		
	QQN-Bisection-2	1.08e0	8.03e-1	4.47e-2	1.98e0	77.5	20.0		
	GD-WeightDecay	2.00e0	4.00e-1	1.19e0	2.77e0	28.1	0.0		
	Adam-Robust	1.88e0	2.51e-1	1.08e0	2.01e0	42.6	0.0		
	Adam-Fast	2.09e0	2.68e-1	1.47e0	2.78e0	47.2	0.0		
	GD-AdaptiveMomentum	2.06e0	3.04e-1	1.28e0	3.01e0	18.7	0.0		
	GD	2.04e0	4.26e-1	1.43e0	3.11e0	21.9	0.0		
	GD-Momentum	2.02e0	5.27e-1	7.01e-1	2.71e0	19.0	0.0		
	Trust Region-Precise	2.04e0	3.89e-1	1.43e0	3.38e0	76.8	0.0		
	GD-Nesterov	1.93e0	3.46e-1	7.77e-1	2.32e0	15.2	0.0		
	Trust Region-Adaptive	2.09e0	5.10e-1	1.46e0	4.04e0	29.6	0.0		
	Trust Region-Standard	2.18e0	4.89e-1	1.43e0	3.40e0	10.7	0.0		

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Trust Region-Aggressive	1.33e2	5.68e2	1.02e0	2.61e3	6.3	0.0		
GoldsteinPrice_2D	**L-BFGS-Limited**	8.41e1	3.33e-1	8.40e1	8.54e1	4259.4	0.0		
	L-BFGS-Aggressive	8.60e2	1.24e1	8.43e2	9.02e2	3847.0	0.0		
	Trust Region-Conservative	2.12e3	1.02e3	8.97e2	4.67e3	3002.0	0.0		
	Trust Region-Precise	2.20e3	1.09e3	8.40e2	4.16e3	2943.8	0.0		
	Trust Region-Adaptive	2.09e3	1.19e3	8.40e2	4.29e3	2649.8	0.0		
	QQN-StrongWolfe	8.34e1	2.81e0	7.11e1	8.40e1	552.0	15.0		
	Adam-AMSGrad	8.40e2	3.17e-2	8.40e2	8.40e2	603.6	0.0		
	Adam	8.40e2	3.55e-2	8.40e2	8.40e2	597.1	0.0		
	QQN-CubicQuadraticInterpolation	2.71e2	3.24e2	8.40e1	8.40e2	291.6	15.0		
	Trust Region-Standard	1.22e3	6.11e2	8.40e2	2.65e3	1684.8	0.0		
	L-BFGS-MoreThuente	1.19e2	1.66e2	2.24e1	8.40e2	621.9	5.0		
	QQN-Bisection-1	8.40e1	1.50e-11	8.40e1	8.40e1	362.8	20.0		
	QQN-GoldenSection	8.40e1	3.02e-11	8.40e1	8.40e1	383.2	35.0		
	L-BFGS-Conservative	8.44e2	1.17e1	8.40e2	8.81e2	346.4	0.0		
	Trust Region-Aggressive	9.54e2	4.95e2	8.40e2	3.11e3	725.5	0.0		
	Adam-WeightDecay	8.40e2	2.73e-1	8.40e2	8.41e2	209.7	0.0		
	L-BFGS	8.00e2	8.72e2	6.35e1	3.89e3	176.8	5.0		
	Adam-Robust	8.41e2	1.02e0	8.40e2	8.43e2	81.0	0.0		
	GD-Nesterov	8.57e2	1.92e1	8.40e2	9.22e2	24.6	0.0		
	QQN-Bisection-2	1.58e2	1.99e2	8.40e1	8.40e2	21.2	5.0		
	Adam-Fast	8.55e2	1.83e1	8.40e2	9.15e2	35.3	0.0		
	GD-AdaptiveMomentum	8.45e2	4.79e0	8.41e2	8.57e2	19.9	0.0		
	GD	8.50e2	4.11e0	8.41e2	8.55e2	24.6	0.0		
	GD-WeightDecay	8.57e2	1.90e1	8.40e2	9.08e2	20.3	0.0		
	GD-Momentum	8.98e2	2.94e2	9.88e1	1.93e3	17.9	0.0		
Matyas_2D	**Adam-AMSGrad**	2.50e-2	1.14e-5	2.50e-2	2.50e-2	680.7	100.0		
	GD	2.50e-2	5.93e-6	2.50e-2	2.50e-2	629.6	100.0		
	Adam	2.50e-2	1.45e-5	2.49e-2	2.50e-2	624.2	100.0		
	GD-WeightDecay	2.50e-2	1.46e-5	2.50e-2	2.50e-2	223.7	100.0		
	Adam-WeightDecay	2.49e-2	5.00e-5	2.48e-2	2.50e-2	221.4	100.0		
	GD-Nesterov	2.49e-2	5.97e-5	2.48e-2	2.50e-2	71.0	100.0		
	GD-Momentum	2.49e-2	6.76e-5	2.48e-2	2.50e-2	67.2	100.0		
	L-BFGS-Aggressive	2.44e-2	3.00e-3	2.16e-2	3.66e-2	217.4	95.0		
	Adam-Robust	2.48e-2	1.11e-4	2.46e-2	2.50e-2	79.0	100.0		
	QQN-GoldenSection	1.55e-2	6.76e-3	1.12e-3	2.47e-2	138.9	100.0		
	GD-AdaptiveMomentum	2.52e-2	2.56e-3	2.42e-2	3.63e-2	29.2	95.0		
	QQN-Bisection-2	1.49e-2	6.16e-3	8.19e-4	2.50e-2	40.9	100.0		
	QQN-CubicQuadraticInterpolation	1.07e-2	9.48e-3	2.70e-30	2.47e-2	34.0	100.0		
	QQN-Bisection-1	1.91e-2	5.76e-3	2.83e-3	2.50e-2	34.2	100.0		
	L-BFGS-Conservative	2.30e-2	1.27e-3	2.07e-2	2.49e-2	39.0	100.0		
	QQN-StrongWolfe	2.73e-29	3.90e-29	1.77e-32	1.69e-28	24.0	100.0		
	L-BFGS-Limited	1.73e-2	5.34e-3	7.16e-3	2.46e-2	24.6	100.0		
	L-BFGS	1.47e-2	9.70e-3	5.88e-4	2.50e-2	20.1	100.0		
	Adam-Fast	2.30e-2	1.45e-3	1.98e-2	2.49e-2	12.9	100.0		
	L-BFGS-MoreThuente	1.72e-2	8.74e-3	2.59e-5	2.46e-2	20.8	100.0		
	Trust Region-Standard	2.41e-1	1.19e-1	3.14e-2	3.36e-1	7.2	0.0		
	Trust Region-Adaptive	6.88e-2	1.85e-2	2.83e-2	8.71e-2	7.0	0.0		
	Trust Region-Conservative	3.93e-2	6.90e-3	2.66e-2	5.75e-2	7.0	0.0		
	Trust Region-Aggressive	6.67e-1	6.95e-1	2.86e-2	1.50e0	6.3	0.0		
	Trust Region-Precise	4.71e-2	8.16e-3	3.00e-2	5.69e-2	5.0	0.0		
Himmelblau_2D	**Adam-Robust**	1.05e2	5.73e0	9.10e1	1.15e2	2502.0	0.0		
	Adam-AMSGrad	8.17e1	5.99e0	7.19e1	9.17e1	2502.0	0.0		
	Adam	8.20e1	5.99e0	7.20e1	9.40e1	2502.0	0.0		
	Adam-WeightDecay	2.41e-1	4.02e-3	2.34e-1	2.48e-1	1744.1	100.0		
	L-BFGS-Aggressive	3.44e1	1.81e1	4.95e0	7.59e1	3850.9	0.0		
	Trust Region-Precise	1.07e2	3.03e0	1.02e2	1.12e2	3002.0	0.0		
	Trust Region-Conservative	1.60e2	3.17e0	1.52e2	1.65e2	3002.0	0.0		
	Trust Region-Adaptive	1.32e-1	5.93e-2	7.13e-2	2.46e-1	2048.1	100.0		
	L-BFGS-Conservative	2.03e-1	2.91e-2	1.42e-1	2.47e-1	264.2	100.0		
	Trust Region-Standard	1.50e-1	8.67e-2	3.76e-3	3.03e-1	516.7	80.0		
	QQN-Bisection-1	1.09e-1	4.94e-2	2.06e-2	2.13e-1	107.9	100.0		
	QQN-CubicQuadraticInterpolation	9.46e-2	7.76e-2	5.19e-3	2.45e-1	68.0	100.0		
	Adam-Fast	5.29e0	2.08e-1	4.98e0	5.82e0	69.3	0.0		
	QQN-StrongWolfe	9.18e-2	6.79e-2	9.60e-3	2.15e-1	61.5	100.0		
	L-BFGS	6.22e0	5.64e0	1.56e-2	1.80e1	93.7	35.0		
	QQN-GoldenSection	7.91e-2	6.51e-2	1.17e-4	2.36e-1	102.8	100.0		
	GD	1.53e-1	6.88e-2	2.80e-2	2.41e-1	42.9	100.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	L-BFGS-Limited	9.58e-2	8.02e-2	7.81e-3	2.40e-1	60.9	100.0		
	QQN-Bisection-2	8.17e-2	6.08e-2	2.27e-3	2.05e-1	55.1	100.0		
	GD-WeightDecay	3.93e-1	4.16e-1	8.90e-2	1.20e0	29.6	75.0		
	Trust Region-Aggressive	6.71e-1	4.77e-1	1.80e-2	1.52e0	133.1	25.0		
	GD-Nesterov	9.49e0	7.94e0	3.27e-2	2.11e1	26.7	40.0		
	GD-AdaptiveMomentum	6.94e1	3.44e0	5.87e1	7.33e1	22.8	0.0		
	GD-Momentum	4.37e1	1.60e1	3.43e0	7.63e1	24.3	0.0		
	L-BFGS-MoreThuente	1.02e-1	7.28e-2	8.92e-3	2.39e-1	36.3	100.0		
Booth_2D	**Adam-AMSGrad**	1.19e1	2.01e0	8.69e0	1.53e1	2502.0	0.0		
	Adam-Robust	2.03e1	2.55e0	1.43e1	2.49e1	2502.0	0.0		
	Adam	1.20e1	2.17e0	8.76e0	1.67e1	2502.0	0.0		
	Adam-WeightDecay	1.19e-1	3.80e-4	1.19e-1	1.20e-1	1886.3	100.0		
	L-BFGS-Aggressive	7.43e1	5.77e0	6.24e1	8.60e1	3852.0	0.0		
	Trust Region-Precise	1.05e1	5.90e0	2.82e0	2.22e1	3002.0	0.0		
	Trust Region-Conservative	6.49e1	6.14e0	5.04e1	7.80e1	3002.0	0.0		
	Trust Region-Adaptive	6.12e-2	3.24e-2	2.38e-2	1.24e-1	919.9	90.0		
	L-BFGS-Conservative	1.10e-1	5.23e-3	1.03e-1	1.20e-1	208.0	100.0		
	QQN-Bisection-1	1.87e-2	1.86e-2	1.21e-2	9.94e-2	162.4	100.0		
	GD	1.17e-1	1.31e-3	1.15e-1	1.20e-1	86.0	100.0		
	QQN-Bisection-2	1.49e-2	2.92e-3	1.15e-2	2.20e-2	100.0	100.0		
	Trust Region-Standard	5.27e-1	1.54e-1	3.46e-1	7.93e-1	235.1	0.0		
	QQN-CubicQuadraticInterpolation	2.56e-6	2.13e-6	2.81e-7	7.40e-6	56.0	100.0		
	Adam-Fast	3.09e0	2.17e-1	2.74e0	3.45e0	56.3	0.0		
	L-BFGS-Limited	6.14e-2	3.83e-2	2.04e-3	1.13e-1	56.1	100.0		
	QQN-GoldenSection	3.39e-2	1.16e-2	1.60e-2	5.86e-2	92.0	100.0		
	GD-WeightDecay	1.29e0	5.10e-1	1.15e-1	1.73e0	27.0	15.0		
	GD-AdaptiveMomentum	9.51e0	8.38e-1	8.56e0	1.11e1	21.0	0.0		
	GD-Nesterov	2.56e0	2.92e-1	2.10e0	2.95e0	20.6	0.0		
	L-BFGS	4.05e-2	1.53e-2	1.17e-2	6.97e-2	42.4	100.0		
	GD-Momentum	7.27e0	3.58e-1	6.20e0	8.01e0	21.2	0.0		
	Trust Region-Aggressive	1.49e0	4.64e-1	4.00e-1	2.38e0	63.5	0.0		
	L-BFGS-MoreThuente	3.86e-2	3.42e-2	5.15e-4	1.13e-1	29.7	100.0		
	QQN-StrongWolfe	1.13e-2	7.50e-4	9.93e-3	1.29e-2	26.0	100.0		
Griewank_2D	**L-BFGS-Aggressive**	4.91e0	7.72e-3	4.91e0	4.95e0	2427.6	0.0		
	Adam-AMSGrad	5.24e0	4.70e-2	5.16e0	5.30e0	2502.0	0.0		
	Adam-Robust	5.36e0	6.83e-2	5.26e0	5.48e0	2502.0	0.0		
	Adam	5.24e0	4.43e-2	5.16e0	5.30e0	2502.0	0.0		
	Adam-WeightDecay	4.92e0	2.42e-6	4.92e0	4.92e0	2231.2	0.0		
	GD	4.91e0	3.24e-8	4.91e0	4.91e0	1668.0	0.0		
	L-BFGS-Limited	4.91e0	4.49e-8	4.91e0	4.91e0	927.3	0.0		
	QQN-StrongWolfe	4.74e0	3.50e-1	3.76e0	4.91e0	347.6	0.0		
	GD-WeightDecay	4.91e0	1.03e-7	4.91e0	4.91e0	406.6	0.0		
	L-BFGS-Conservative	4.91e0	3.09e-9	4.91e0	4.91e0	504.6	0.0		
	L-BFGS	4.91e0	3.75e-8	4.91e0	4.91e0	295.6	0.0		
	QQN-GoldenSection	4.91e0	1.03e-13	4.91e0	4.91e0	258.3	0.0		
	GD-Nesterov	4.91e0	1.90e-4	4.91e0	4.91e0	125.0	0.0		
	GD-Momentum	4.91e0	4.49e-4	4.91e0	4.91e0	100.2	0.0		
	Trust Region-Conservative	4.92e0	2.48e-3	4.91e0	4.92e0	336.5	0.0		
	QQN-CubicQuadraticInterpolation	4.80e0	4.73e-1	2.74e0	4.91e0	77.3	0.0		
	QQN-Bisection-2	4.66e0	2.21e-1	4.25e0	4.91e0	94.6	0.0		
	QQN-Bisection-1	4.91e0	1.27e-13	4.91e0	4.91e0	76.3	0.0		
	Adam-Fast	4.93e0	6.09e-3	4.92e0	4.94e0	67.0	0.0		
	L-BFGS-MoreThuente	4.91e0	1.88e-7	4.91e0	4.91e0	73.0	0.0		
	GD-AdaptiveMomentum	4.99e0	5.58e-3	4.97e0	5.00e0	32.0	0.0		
	Trust Region-Precise	4.95e0	1.38e-2	4.93e0	4.97e0	58.7	0.0		
	Trust Region-Adaptive	5.11e0	1.18e-1	5.00e0	5.54e0	16.4	0.0		
	Trust Region-Aggressive	6.00e0	6.58e-2	5.90e0	6.12e0	5.0	0.0		
	Trust Region-Standard	5.99e0	7.24e-2	5.90e0	6.16e0	5.0	0.0		
Griewank_5D	**QQN-StrongWolfe**	1.09e1	2.09e0	5.74e0	1.33e1	1535.0	0.0		
	Adam-Robust	1.29e1	6.91e-2	1.28e1	1.30e1	2502.0	0.0		
	Adam-AMSGrad	1.25e1	2.91e-2	1.25e1	1.26e1	2502.0	0.0		
	Adam	1.25e1	2.35e-2	1.25e1	1.25e1	2502.0	0.0		
	GD	1.22e1	1.06e-3	1.22e1	1.22e1	1668.0	0.0		
	Adam-WeightDecay	1.23e1	6.65e-3	1.23e1	1.23e1	1651.7	0.0		
	GD-WeightDecay	1.22e1	1.86e-5	1.22e1	1.22e1	915.3	0.0		
	QQN-Bisection-2	1.21e1	5.61e-1	9.76e0	1.22e1	984.9	0.0		
	QQN-GoldenSection	1.12e1	3.02e0	1.62e0	1.22e1	1154.2	0.0		
	QQN-Bisection-1	1.06e1	3.32e0	2.18e0	1.22e1	872.0	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	L-BFGS-Conservative	1.22e1	5.00e-9	1.22e1	1.22e1	705.6	0.0		
	L-BFGS-Limited	1.22e1	6.36e-8	1.22e1	1.22e1	632.5	0.0		
	L-BFGS-Aggressive	1.09e1	2.56e0	5.15e0	1.22e1	1097.7	0.0		
	GD-Nesterov	1.22e1	3.21e-9	1.22e1	1.22e1	394.2	0.0		
	GD-Momentum	1.22e1	2.51e-9	1.22e1	1.22e1	387.2	0.0		
	L-BFGS	1.22e1	4.05e-3	1.22e1	1.23e1	259.7	0.0		
	GD-AdaptiveMomentum	1.23e1	3.47e-2	1.22e1	1.23e1	133.1	0.0		
	QQN-CubicQuadraticInterpolation	1.28e1	2.58e-1	1.22e1	1.32e1	115.1	0.0		
	Trust Region-Conservative	1.23e1	2.20e-3	1.23e1	1.23e1	380.4	0.0		
	L-BFGS-MoreThuente	1.22e1	2.35e-7	1.22e1	1.22e1	118.5	0.0		
	Adam-Fast	1.23e1	1.71e-2	1.22e1	1.23e1	67.1	0.0		
	Trust Region-Precise	1.34e1	3.58e-1	1.23e1	1.36e1	11.4	0.0		
	Trust Region-Aggressive	1.35e1	2.50e-2	1.35e1	1.35e1	5.0	0.0		
	Trust Region-Adaptive	1.35e1	3.00e-2	1.34e1	1.35e1	5.0	0.0		
	Trust Region-Standard	1.35e1	2.54e-2	1.34e1	1.36e1	5.0	0.0		
Griewank_10D	**QQN-StrongWolfe**	6.06e0	1.00e1	9.86e-3	2.60e1	2281.2	0.0		
	QQN-GoldenSection	2.35e1	6.71e0	2.19e0	2.58e1	4343.6	0.0		
	QQN-Bisection-2	2.33e1	7.17e0	1.67e0	2.58e1	3260.0	0.0		
	QQN-Bisection-1	2.19e1	9.08e0	5.93e-10	2.58e1	2381.1	5.0		
	Adam-AMSGrad	2.54e1	2.09e-2	2.53e1	2.54e1	2502.0	0.0		
	Adam-Robust	2.55e1	2.00e-2	2.55e1	2.55e1	2502.0	0.0		
	GD-WeightDecay	2.48e1	3.83e-2	2.48e1	2.49e1	1668.0	0.0		
	GD-Nesterov	2.21e1	2.17e-1	2.15e1	2.23e1	1668.0	0.0		
	Adam-WeightDecay	2.42e1	1.44e-2	2.41e1	2.42e1	2502.0	0.0		
	L-BFGS-Limited	1.95e1	3.46e0	8.48e0	2.38e1	2256.7	0.0		
	Adam	2.54e1	2.20e-2	2.53e1	2.54e1	2502.0	0.0		
	L-BFGS-Aggressive	6.09e0	5.66e0	1.01e0	2.16e1	3817.8	0.0		
	GD-Momentum	2.20e1	3.14e-1	2.16e1	2.24e1	1668.0	0.0		
	L-BFGS-Conservative	2.33e1	1.54e0	2.01e1	2.49e1	1668.3	0.0		
	GD	2.56e1	2.73e-2	2.55e1	2.57e1	1668.0	0.0		
	GD-AdaptiveMomentum	1.90e1	3.00e0	1.39e1	2.12e1	920.4	0.0		
	Adam-Fast	1.17e1	3.56e0	2.89e0	1.50e1	950.2	0.0		
	L-BFGS	1.93e1	3.27e0	1.20e1	2.43e1	483.9	0.0		
	Trust Region-Conservative	2.08e1	2.32e0	1.60e1	2.43e1	1557.3	0.0		
	L-BFGS-MoreThuente	1.42e1	5.29e0	1.93e0	2.12e1	499.3	0.0		
	QQN-CubicQuadraticInterpolation	2.45e1	5.40e0	9.67e-1	2.58e1	108.6	0.0		
	Trust Region-Aggressive	2.60e1	1.61e-2	2.60e1	2.60e1	5.0	0.0		
	Trust Region-Adaptive	2.60e1	1.74e-2	2.60e1	2.60e1	5.0	0.0		
	Trust Region-Precise	2.60e1	1.72e-2	2.60e1	2.60e1	5.0	0.0		
	Trust Region-Standard	2.60e1	2.15e-2	2.60e1	2.60e1	5.0	0.0		
Schwefel_2D	**Adam-Robust**	9.37e2	6.80e-1	9.36e2	9.39e2	2502.0	0.0		
	Adam-AMSGrad	9.35e2	7.05e-1	9.34e2	9.36e2	2502.0	0.0		
	L-BFGS-Conservative	7.11e2	3.94e-8	7.11e2	7.11e2	2095.3	0.0		
	Adam-WeightDecay	9.10e2	8.43e-1	9.09e2	9.12e2	2502.0	0.0		
	Adam	9.35e2	7.54e-1	9.33e2	9.36e2	2502.0	0.0		
	GD	7.11e2	9.48e-4	7.11e2	7.11e2	1668.0	0.0		
	Adam-Fast	7.11e2	9.21e-8	7.11e2	7.11e2	1972.4	0.0		
	GD-WeightDecay	7.11e2	1.75e-8	7.11e2	7.11e2	1115.0	0.0		
	Trust Region-Conservative	9.37e2	8.10e-1	9.35e2	9.39e2	3002.0	0.0		
	Trust Region-Precise	8.84e2	7.64e-1	8.83e2	8.86e2	3002.0	0.0		
	Trust Region-Adaptive	7.11e2	6.05e-2	7.11e2	7.11e2	2834.8	0.0		
	QQN-StrongWolfe	-7.26e2	2.56e3	-1.07e4	5.92e2	379.3	50.0		
	L-BFGS-Limited	7.11e2	7.58e-7	7.11e2	7.11e2	513.3	0.0		
	GD-Nesterov	7.11e2	1.78e-7	7.11e2	7.11e2	292.6	0.0		
	GD-Momentum	7.11e2	1.13e-7	7.11e2	7.11e2	277.4	0.0		
	L-BFGS	7.11e2	5.60e-4	7.11e2	7.11e2	292.1	0.0		
	Trust Region-Standard	7.12e2	2.41e-1	7.12e2	7.12e2	711.8	0.0		
	L-BFGS-MoreThuente	7.11e2	1.08e-4	7.11e2	7.11e2	147.6	0.0		
	GD-AdaptiveMomentum	7.12e2	3.92e-2	7.12e2	7.12e2	89.0	0.0		
	QQN-GoldenSection	7.11e2	1.80e-4	7.11e2	7.11e2	145.1	0.0		
	L-BFGS-Aggressive	7.11e2	2.18e-2	7.11e2	7.11e2	101.0	0.0		
	QQN-CubicQuadraticInterpolation	7.11e2	0.00e0	7.11e2	7.11e2	57.9	0.0		
	Trust Region-Aggressive	7.17e2	6.24e-1	7.16e2	7.18e2	179.0	0.0		
	QQN-Bisection-1	7.11e2	3.40e-13	7.11e2	7.11e2	47.6	0.0		
	QQN-Bisection-2	7.11e2	0.00e0	7.11e2	7.11e2	50.9	0.0		
Schwefel_5D	**L-BFGS-Conservative**	1.78e3	1.53e-7	1.78e3	1.78e3	2163.4	0.0		
	Adam-AMSGrad	2.34e3	1.27e0	2.34e3	2.34e3	2502.0	0.0		
	Adam-Robust	2.34e3	1.19e0	2.34e3	2.34e3	2502.0	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Adam-WeightDecay	2.28e3	1.09e0	2.27e3	2.28e3	2502.0	0.0		
	Adam	2.34e3	1.25e0	2.33e3	2.34e3	2502.0	0.0		
	GD	1.78e3	1.99e-3	1.78e3	1.78e3	1668.0	0.0		
	Adam-Fast	1.78e3	1.99e-7	1.78e3	1.78e3	1907.4	0.0		
	GD-WeightDecay	1.78e3	4.13e-8	1.78e3	1.78e3	1124.1	0.0		
	Trust Region-Adaptive	2.12e3	1.37e0	2.11e3	2.12e3	3002.0	0.0		
	Trust Region-Conservative	2.36e3	1.17e0	2.35e3	2.36e3	3002.0	0.0		
	Trust Region-Precise	2.30e3	1.15e0	2.30e3	2.31e3	3002.0	0.0		
	L-BFGS-Limited	1.79e3	5.71e1	1.78e3	2.04e3	661.0	0.0		
	QQN-StrongWolfe	-1.74e3	7.34e3	-3.30e4	1.48e3	349.1	50.0		
	Trust Region-Standard	1.78e3	2.49e-1	1.78e3	1.78e3	1774.8	0.0		
	GD-Nesterov	1.78e3	2.86e-7	1.78e3	1.78e3	339.1	0.0		
	GD-Momentum	1.78e3	2.50e-7	1.78e3	1.78e3	323.9	0.0		
	L-BFGS	1.78e3	5.48e-4	1.78e3	1.78e3	325.7	0.0		
	GD-AdaptiveMomentum	1.78e3	1.03e-1	1.78e3	1.78e3	124.3	0.0		
	L-BFGS-MoreThuente	1.78e3	9.47e-6	1.78e3	1.78e3	158.2	0.0		
	Trust Region-Aggressive	1.78e3	9.61e-1	1.78e3	1.78e3	446.0	0.0		
	QQN-GoldenSection	1.78e3	4.96e-13	1.78e3	1.78e3	149.4	0.0		
	L-BFGS-Aggressive	1.78e3	4.59e-2	1.78e3	1.78e3	101.0	0.0		
	QQN-CubicQuadraticInterpolation	1.78e3	4.55e-13	1.78e3	1.78e3	57.3	0.0		
	QQN-Bisection-1	1.78e3	4.55e-13	1.78e3	1.78e3	52.0	0.0		
	QQN-Bisection-2	1.78e3	4.69e-13	1.78e3	1.78e3	52.0	0.0		
Schwefel_10D	**L-BFGS-Conservative**	3.55e3	2.96e-7	3.55e3	3.55e3	2188.9	0.0		
	Adam-Robust	4.69e3	1.88e0	4.68e3	4.69e3	2502.0	0.0		
	Adam-AMSGrad	4.67e3	1.85e0	4.67e3	4.68e3	2502.0	0.0		
	Adam-WeightDecay	4.55e3	1.50e0	4.55e3	4.56e3	2502.0	0.0		
	Adam	4.67e3	2.21e0	4.67e3	4.68e3	2502.0	0.0		
	GD	3.55e3	8.86e-3	3.55e3	3.55e3	1668.0	0.0		
	GD-WeightDecay	3.55e3	6.30e-8	3.55e3	3.55e3	1194.6	0.0		
	Adam-Fast	3.55e3	1.08e-7	3.55e3	3.55e3	1628.7	0.0		
	Trust Region-Adaptive	4.48e3	1.82e0	4.48e3	4.49e3	3002.0	0.0		
	Trust Region-Conservative	4.72e3	1.20e0	4.72e3	4.73e3	3002.0	0.0		
	Trust Region-Precise	4.67e3	1.71e0	4.67e3	4.67e3	3002.0	0.0		
	Trust Region-Standard	3.73e3	2.12e0	3.73e3	3.74e3	3002.0	0.0		
	L-BFGS-Limited	3.55e3	3.01e1	3.42e3	3.55e3	577.7	0.0		
	QQN-StrongWolfe	8.35e2	1.64e3	-2.28e3	2.96e3	395.5	50.0		
	GD-Nesterov	3.55e3	8.72e-7	3.55e3	3.55e3	392.1	0.0		
	GD-Momentum	3.55e3	6.50e-7	3.55e3	3.55e3	380.3	0.0		
	L-BFGS	3.55e3	1.15e-2	3.55e3	3.55e3	300.9	0.0		
	Trust Region-Aggressive	3.56e3	1.17e0	3.56e3	3.56e3	888.8	0.0		
	GD-AdaptiveMomentum	3.55e3	5.29e-2	3.55e3	3.55e3	164.1	0.0		
	L-BFGS-MoreThuente	3.55e3	1.12e-3	3.55e3	3.55e3	159.3	0.0		
	QQN-GoldenSection	3.55e3	9.37e-13	3.55e3	3.55e3	147.8	0.0		
	L-BFGS-Aggressive	3.55e3	4.65e-2	3.55e3	3.55e3	101.0	0.0		
	QQN-CubicQuadraticInterpolation	3.55e3	1.43e-3	3.55e3	3.55e3	56.9	0.0		
	QQN-Bisection-1	3.55e3	9.09e-13	3.55e3	3.55e3	52.0	0.0		
	QQN-Bisection-2	3.55e3	9.09e-13	3.55e3	3.55e3	52.0	0.0		
Levy_2D	**Adam-Robust**	4.34e-2	2.28e-2	1.83e-2	9.34e-2	2502.0	0.0		
	Adam-AMSGrad	2.61e-2	1.26e-2	1.24e-2	5.59e-2	2502.0	0.0		
	Adam	5.69e-3	3.31e-3	1.60e-3	1.48e-2	2502.0	0.0		
	Adam-WeightDecay	9.83e-7	7.75e-9	9.67e-7	9.98e-7	2229.0	100.0		
	GD-WeightDecay	9.96e-7	1.94e-9	9.93e-7	1.00e-6	1453.5	100.0		
	GD	2.39e-4	2.63e-5	1.85e-4	2.75e-4	1668.0	0.0		
	L-BFGS-Aggressive	6.19e-4	9.61e-4	6.80e-8	2.64e-3	1303.1	70.0		
	L-BFGS-Conservative	9.25e-7	1.12e-6	8.80e-8	5.33e-6	626.6	85.0		
	L-BFGS-Limited	1.05e-6	8.37e-7	1.49e-7	4.54e-6	583.7	95.0		
	L-BFGS	7.38e-3	2.81e-2	1.57e-7	1.29e-1	285.0	80.0		
	L-BFGS-MoreThuente	5.43e-6	2.10e-5	7.84e-9	9.69e-5	286.5	95.0		
	QQN-GoldenSection	1.81e-7	2.48e-7	1.48e-10	8.51e-7	300.9	100.0		
	Trust Region-Conservative	1.34e-2	2.06e-3	9.88e-3	1.65e-2	385.2	0.0		
	QQN-CubicQuadraticInterpolation	8.29e-8	1.84e-7	5.12e-10	8.65e-7	87.6	100.0		
	QQN-StrongWolfe	2.98e-7	3.89e-7	1.89e-10	9.85e-7	79.0	100.0		
	QQN-Bisection-1	1.15e-7	1.44e-7	2.81e-9	5.10e-7	102.2	100.0		
	QQN-Bisection-2	1.80e-7	2.24e-7	2.53e-9	8.17e-7	93.0	100.0		
	Adam-Fast	7.87e-2	4.29e-3	7.26e-2	8.98e-2	36.5	0.0		
	GD-Nesterov	1.31e-1	2.65e-2	9.69e-2	1.81e-1	22.4	0.0		
	GD-Momentum	1.57e-1	2.47e-2	1.15e-1	2.20e-1	22.5	0.0		
	Trust Region-Precise	6.16e-2	3.23e-2	3.16e-2	1.88e-1	70.6	0.0		

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	GD-AdaptiveMomentum	3.36e-1	5.15e-2	2.35e-1	4.11e-1	16.4	0.0		
	Trust Region-Adaptive	1.01e1	2.44e1	6.77e-2	1.07e2	27.2	0.0		
	Trust Region-Standard	3.36e0	7.59e0	1.74e-3	2.47e1	18.2	0.0		
	Trust Region-Aggressive	1.31e0	2.09e-1	9.21e-1	1.57e0	5.0	0.0		
Levy_5D	**Adam-Robust**	6.80e-2	2.38e-2	3.18e-2	1.12e-1	2502.0	0.0		
	Adam-AMSGrad	7.64e-2	1.84e-2	5.66e-2	1.23e-1	2502.0	0.0		
	Adam	7.73e-3	2.59e-3	3.13e-3	1.23e-2	2502.0	0.0		
	Adam-WeightDecay	1.43e-6	8.78e-7	9.65e-7	3.66e-6	2087.2	60.0		
	GD-WeightDecay	9.96e-7	2.36e-9	9.93e-7	1.00e-6	1448.8	100.0		
	GD	2.32e-4	2.08e-5	1.98e-4	2.68e-4	1668.0	0.0		
	L-BFGS-Limited	2.87e-4	1.19e-3	2.75e-7	5.49e-3	1375.8	70.0		
	L-BFGS-Aggressive	2.73e-2	8.04e-2	6.19e-7	2.69e-1	825.3	75.0		
	L-BFGS-Conservative	6.68e-7	2.83e-7	1.69e-8	9.92e-7	332.8	100.0		
	Trust Region-Conservative	1.23e-2	2.42e-3	8.28e-3	1.73e-2	996.6	0.0		
	QQN-GoldenSection	2.57e-7	2.61e-7	1.77e-10	8.61e-7	382.3	100.0		
	L-BFGS-MoreThuente	6.91e-7	2.89e-7	1.12e-9	9.44e-7	296.9	100.0		
	L-BFGS	4.35e-2	1.89e-1	2.47e-7	8.69e-1	173.6	80.0		
	GD-Nesterov	9.57e-2	5.82e-2	9.78e-7	1.77e-1	102.2	25.0		
	QQN-CubicQuadraticInterpolation	2.65e-7	2.41e-7	2.28e-9	8.78e-7	96.0	100.0		
	QQN-Bisection-1	3.74e-7	3.37e-7	4.32e-9	9.98e-7	103.4	100.0		
	QQN-Bisection-2	2.16e-7	2.19e-7	1.51e-10	8.82e-7	101.3	100.0		
	QQN-StrongWolfe	3.31e-7	3.09e-7	1.45e-9	9.50e-7	69.2	100.0		
	GD-Momentum	1.72e-1	6.34e-2	9.75e-7	2.44e-1	56.5	10.0		
	Trust Region-Precise	3.62e-2	1.15e-2	1.69e-2	5.90e-2	168.1	0.0		
	Adam-Fast	1.67e-1	6.57e-3	1.54e-1	1.81e-1	37.0	0.0		
	GD-AdaptiveMomentum	4.77e-1	4.91e-2	3.80e-1	5.58e-1	19.2	0.0		
	Trust Region-Adaptive	1.06e1	3.16e1	4.60e-2	1.07e2	46.9	0.0		
	Trust Region-Standard	2.49e0	5.26e0	4.43e-4	2.47e1	26.4	0.0		
	Trust Region-Aggressive	4.37e-1	1.99e-1	1.82e-1	1.11e0	8.2	0.0		
Levy_10D	**Adam-Robust**	9.82e-2	2.53e-2	6.13e-2	1.55e-1	2502.0	0.0		
	Adam-AMSGrad	1.51e-1	2.79e-2	1.12e-1	2.09e-1	2502.0	0.0		
	Adam	6.46e-3	2.05e-3	2.32e-3	1.09e-2	2502.0	0.0		
	GD-WeightDecay	9.97e-7	2.35e-9	9.93e-7	1.00e-6	1451.7	100.0		
	GD	2.28e-4	3.05e-5	1.85e-4	2.81e-4	1668.0	0.0		
	Adam-WeightDecay	2.80e-6	1.09e-6	1.41e-6	5.43e-6	1897.2	0.0		
	L-BFGS-Aggressive	1.27e0	8.13e-1	4.01e-7	1.95e0	2637.9	25.0		
	L-BFGS-Limited	2.41e-5	9.83e-5	5.25e-7	4.52e-4	1051.8	80.0		
	Trust Region-Conservative	1.21e-2	2.16e-3	9.38e-3	1.68e-2	1976.9	0.0		
	L-BFGS-Conservative	6.63e-7	2.81e-7	7.05e-8	9.84e-7	365.9	100.0		
	QQN-GoldenSection	2.74e-7	3.41e-7	1.87e-10	9.92e-7	399.3	100.0		
	L-BFGS	3.96e-3	1.37e-2	3.36e-7	6.19e-2	223.2	80.0		
	L-BFGS-MoreThuente	7.24e-7	2.59e-7	8.40e-8	9.97e-7	165.1	100.0		
	QQN-CubicQuadraticInterpolation	2.83e-7	2.18e-7	2.06e-9	7.21e-7	98.6	100.0		
	QQN-Bisection-1	2.49e-7	2.81e-7	1.67e-8	9.80e-7	109.7	100.0		
	QQN-Bisection-2	2.70e-7	3.13e-7	1.96e-10	9.48e-7	111.1	100.0		
	Trust Region-Precise	3.14e-2	1.13e-2	1.56e-2	5.18e-2	325.6	0.0		
	QQN-StrongWolfe	1.46e-7	2.27e-7	7.28e-10	8.42e-7	70.1	100.0		
	GD-Nesterov	1.74e-1	1.99e-2	1.40e-1	2.05e-1	28.4	0.0		
	GD-Momentum	2.58e-1	3.43e-2	1.93e-1	3.23e-1	28.1	0.0		
	Adam-Fast	3.12e-1	1.23e-2	2.89e-1	3.41e-1	36.9	0.0		
	GD-AdaptiveMomentum	6.50e-1	3.56e-2	5.54e-1	7.01e-1	21.9	0.0		
	Trust Region-Adaptive	7.36e-2	4.00e-2	1.96e-2	1.41e-1	84.5	0.0		
	Trust Region-Standard	2.04e0	7.08e0	8.10e-2	3.28e1	29.6	0.0		
	Trust Region-Aggressive	6.17e-1	4.58e-1	2.22e-1	1.93e0	11.8	0.0		
Zakharov_2D	**Adam-Robust**	3.83e-2	2.87e-2	6.91e-3	1.35e-1	2502.0			
	Adam-AMSGrad	9.29e-2	2.94e-2	4.85e-2	1.34e-1	2502.0			
	Adam	1.77e-3	1.69e-3	5.24e-5	6.40e-3	2502.0			
	Adam-WeightDecay	9.88e-9	7.13e-11	9.74e-9	9.97e-9	2040.6			
	L-BFGS-Conservative	6.39e-7	1.89e-6	5.41e-10	6.44e-6	863.5			
	Trust Region-Conservative	8.84e-1	1.50e0	1.05e-2	6.57e0	2569.1			
	L-BFGS-Limited	6.46e-7	2.30e-6	1.04e-9	1.04e-5	658.2			
	GD	9.76e-9	9.66e-11	9.61e-9	9.97e-9	417.4			
	L-BFGS-Aggressive	3.75e0	5.80e0	4.91e-10	1.50e1	1213.0			
	Trust Region-Precise	6.91e-2	9.24e-2	8.62e-3	4.38e-1	503.2			
	QQN-StrongWolfe	4.83e-9	2.70e-9	1.51e-9	9.93e-9	95.0			
	L-BFGS	2.88e-2	5.11e-2	5.69e-10	1.73e-1	158.7			
	QQN-CubicQuadraticInterpolation	1.52e-9	3.10e-9	1.85e-11	9.62e-9	89.2			
	QQN-GoldenSection	7.14e-11	3.11e-10	5.21e-21	1.43e-9	180.9			

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	QQN-Bisection-1	7.75e-14	8.83e-14	9.76e-18	3.54e-13	114.6			
	QQN-Bisection-2	9.02e-14	2.34e-13	4.37e-17	9.97e-13	84.0			
	GD-WeightDecay	8.53e-2	5.34e-2	8.63e-9	1.56e-1	47.9			
	L-BFGS-MoreThuente	7.07e-9	1.81e-9	3.76e-9	9.71e-9	67.3			
	Trust Region-Adaptive	4.96e3	2.16e4	3.14e-2	9.91e4	121.0			
	Adam-Fast	2.81e-1	1.57e-2	2.54e-1	3.10e-1	37.5			
	GD-AdaptiveMomentum	7.05e-1	1.56e-1	4.12e-1	1.03e0	16.6			
	GD-Nesterov	6.00e-1	7.84e-2	5.01e-1	7.53e-1	16.7			
	GD-Momentum	1.08e0	1.28e-1	8.96e-1	1.34e0	17.1			
	Trust Region-Standard	2.38e0	4.10e0	1.22e-1	1.46e1	38.3			
	Trust Region-Aggressive	5.16e4	2.24e5	5.33e-1	1.03e6	18.9			
Zakharov_5D	**L-BFGS-Aggressive**	4.22e1	8.64e0	2.82e1	6.13e1	3309.5			
	Adam-AMSGrad	2.23e-2	1.32e-2	4.59e-3	5.39e-2	2502.0			
	Adam-Robust	7.06e-2	7.45e-2	6.18e-3	2.91e-1	2502.0			
	Adam	2.82e-3	2.38e-3	2.65e-4	7.47e-3	2502.0			
	Adam-WeightDecay	8.64e-3	1.13e-2	9.76e-9	2.86e-2	1586.3			
	Trust Region-Precise	3.50e3	7.96e2	2.04e3	4.73e3	3002.0			
	Trust Region-Adaptive	3.10e3	8.27e2	1.77e3	4.98e3	3002.0			
	Trust Region-Conservative	3.28e3	6.15e2	2.05e3	4.46e3	3002.0			
	Trust Region-Standard	2.28e3	8.27e2	6.92e2	3.84e3	3002.0			
	Trust Region-Aggressive	5.65e1	1.12e2	6.02e-1	4.25e2	2415.8			
	L-BFGS-Limited	1.94e-8	4.45e-8	7.85e-9	2.13e-7	1078.6			
	GD	9.78e-9	9.76e-11	9.63e-9	9.97e-9	477.1			
	L-BFGS-MoreThuente	9.32e-9	3.60e-10	8.60e-9	9.95e-9	634.6			
	L-BFGS-Conservative	7.32e-9	2.98e-9	2.42e-10	9.99e-9	492.9			
	QQN-CubicQuadraticInterpolation	1.52e-9	1.59e-9	3.50e-12	5.23e-9	205.0			
	QQN-StrongWolfe	2.41e-9	3.17e-9	2.91e-14	9.91e-9	100.3			
	QQN-Bisection-2	1.50e-9	1.97e-9	2.56e-15	6.16e-9	114.7			
	QQN-Bisection-1	1.12e-12	2.99e-12	5.59e-14	1.40e-11	118.0			
	GD-WeightDecay	7.62e-1	4.69e-1	9.24e-9	1.31e0	52.5			
	QQN-GoldenSection	2.83e-12	2.87e-12	2.45e-13	1.21e-11	138.0			
	L-BFGS	2.69e1	2.46e1	2.58e-1	8.10e1	93.0			
	Adam-Fast	9.66e0	1.31e0	7.78e0	1.15e1	34.8			
	GD-AdaptiveMomentum	6.97e1	1.64e1	4.83e1	1.09e2	18.5			
	GD-Nesterov	5.05e0	2.73e0	1.42e0	1.10e1	18.1			
	GD-Momentum	5.45e1	1.33e1	3.48e1	9.04e1	18.9			
Zakharov_10D	**Adam-Robust**	3.12e0	6.81e0	2.92e-2	2.78e1	2502.0			
	L-BFGS	2.07e4	8.30e3	6.23e3	3.58e4	3286.7			
	L-BFGS-MoreThuente	1.67e-6	9.70e-7	4.87e-7	4.27e-6	2886.3			
	L-BFGS-Aggressive	9.79e-1	8.37e-1	1.37e-2	3.03e0	3811.6			
	Adam	4.52e-2	4.19e-2	1.69e-3	1.18e-1	2253.9			
	Adam-AMSGrad	1.09e-1	3.02e-2	3.67e-2	1.63e-1	2016.2			
	L-BFGS-Limited	9.29e-2	2.40e-1	5.26e-9	9.86e-1	2588.7			
	Trust Region-Standard	5.72e5	1.14e5	3.74e5	8.01e5	3002.0			
	Trust Region-Adaptive	5.56e5	9.19e4	4.08e5	7.62e5	3002.0			
	Trust Region-Precise	5.73e5	9.27e4	4.07e5	7.69e5	3002.0			
	Trust Region-Aggressive	5.60e5	8.22e4	4.02e5	7.12e5	3002.0			
	Trust Region-Conservative	5.85e5	6.69e4	4.55e5	7.39e5	3002.0			
	GD	3.37e-1	2.28e-1	9.65e-9	9.78e-1	686.0			
	Adam-WeightDecay	1.79e-1	3.62e-2	1.29e-1	2.61e-1	683.1			
	QQN-CubicQuadraticInterpolation	1.75e-9	9.69e-10	4.53e-10	4.49e-9	312.8			
	QQN-StrongWolfe	9.67e-4	4.21e-3	2.12e-14	1.93e-2	281.4			
	QQN-Bisection-2	1.58e-9	9.47e-10	1.13e-10	3.31e-9	159.2			
	QQN-GoldenSection	1.50e-9	2.57e-9	3.14e-19	8.28e-9	233.1			
	QQN-Bisection-1	1.96e-9	2.69e-9	4.68e-16	8.14e-9	161.5			
	GD-WeightDecay	1.51e1	1.85e1	8.77e-9	5.75e1	67.5			
	L-BFGS-Conservative	7.82e23	1.19e24	1.68e5	4.59e24	68.5			
	Adam-Fast	1.13e3	5.38e2	3.62e2	2.13e3	34.7			
	GD-AdaptiveMomentum	6.98e3	2.36e3	4.52e3	1.36e4	20.9			
	GD-Nesterov	8.62e2	6.04e2	4.52e1	1.76e3	20.2			
	GD-Momentum	6.41e3	3.22e3	1.95e3	1.10e4	21.1			
IllConditionedRosenbrock_2D_alpha100	**QQN-GoldenSection**	1.25e-1	5.78e-2	6.99e-5	1.93e-1	4459.4			
	QQN-CubicQuadraticInterpolation	3.48e-2	3.38e-2	4.34e-10	9.89e-2	1722.9			
	QQN-StrongWolfe	5.46e-2	7.38e-2	9.29e-9	3.11e-1	2343.8			
	QQN-Bisection-1	4.65e-1	8.86e-1	1.58e-8	3.18e0	2369.2			
	Adam	1.22e0	3.51e-1	4.86e-1	1.76e0	2502.0			
	L-BFGS-Conservative	2.69e-4	1.04e-3	2.05e-9	4.76e-3	1800.6			
	L-BFGS-Aggressive	3.18e1	2.86e1	4.34e0	1.12e2	3852.0			

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
	L-BFGS-MoreThuente	1.52e-2	6.51e-2	3.79e-9	2.99e-1	1487.5		
	L-BFGS-Limited	3.93e0	5.18e0	3.26e-2	1.96e1	2251.6		
	GD	1.23e0	1.46e0	7.46e-1	6.37e0	854.0		
	Trust Region-Conservative	2.84e1	2.98e1	1.90e-1	1.23e2	2770.7		
	Adam-AMSGrad	3.83e0	1.33e0	4.66e-1	4.75e0	678.1		
	QQN-Bisection-2	5.88e-2	7.05e-2	6.64e-9	2.52e-1	479.6		
	Adam-Robust	4.04e0	8.59e-1	1.90e0	4.73e0	419.2		
	Adam-Fast	2.13e0	2.75e0	2.59e-5	8.39e0	313.6		
	Trust Region-Precise	7.26e0	8.07e0	3.76e0	3.52e1	946.2		
	Adam-WeightDecay	4.11e0	9.66e-1	1.55e-2	4.69e0	231.9		
	Trust Region-Adaptive	4.12e0	2.07e-1	3.83e0	4.42e0	494.4		
	GD-WeightDecay	3.65e0	3.07e0	3.75e-2	1.07e1	58.7		
	GD-AdaptiveMomentum	8.18e-1	1.24e0	4.17e-2	4.36e0	49.2		
	L-BFGS	1.36e2	1.58e2	8.12e-1	5.03e2	121.5		
	GD-Nesterov	1.49e0	1.88e0	5.05e-2	5.63e0	46.1		
	GD-Momentum	5.61e0	3.44e0	4.79e-1	1.33e1	23.8		
	Trust Region-Standard	4.18e0	1.83e-1	3.95e0	4.51e0	89.6		
	Trust Region-Aggressive	4.66e0	3.99e-1	4.01e0	5.49e0	27.6		
IllConditionedRosenbrock_5D_alpha100	**QQN-GoldenSection**	4.32e-1	5.14e-1	5.69e-8	1.61e0	3805.3		
	QQN-CubicQuadraticInterpolation	1.97e-1	2.84e-1	4.07e-9	7.25e-1	1403.3		
	Adam-Robust	1.46e1	6.99e0	6.12e0	2.99e1	2502.0		
	Adam-AMSGrad	4.40e0	3.25e-1	3.25e0	4.82e0	2442.0		
	Adam	3.92e0	4.66e-1	2.83e0	4.65e0	2471.6		
	L-BFGS-Limited	4.05e-1	5.13e-2	3.00e-1	5.47e-1	4035.2		
	QQN-Bisection-2	2.99e-1	2.82e-1	4.91e-8	9.11e-1	1647.8		
	L-BFGS-MoreThuente	1.74e8	7.57e8	3.07e-7	3.47e9	2320.8		
	QQN-Bisection-1	4.19e-1	1.11e0	2.00e-9	4.64e0	1511.2		
	Adam-WeightDecay	1.84e0	2.24e0	1.84e-3	4.66e0	1797.3		
	QQN-StrongWolfe	1.59e-7	1.68e-7	2.70e-9	5.77e-7	1191.3		
	L-BFGS-Conservative	2.02e1	6.75e1	2.46e-1	3.11e2	3386.6		
	L-BFGS-Aggressive	8.07e2	4.06e2	1.72e1	1.19e3	3851.6		
	Trust Region-Conservative	1.02e3	1.63e2	7.14e2	1.31e3	3002.0		
	Trust Region-Precise	1.01e3	1.27e2	8.08e2	1.35e3	3002.0		
	Trust Region-Adaptive	8.41e2	1.37e2	5.05e2	1.11e3	3002.0		
	Trust Region-Standard	6.23e1	7.73e1	4.66e0	2.53e2	2827.2		
	GD-WeightDecay	7.32e-1	1.11e0	1.46e-1	5.40e0	459.3		
	GD-Nesterov	4.24e0	5.00e0	3.82e-1	1.31e1	372.4		
	Trust Region-Aggressive	5.00e0	4.17e-1	4.66e0	5.93e0	776.1		
	L-BFGS	1.50e2	2.28e2	1.98e1	7.52e2	135.3		
	Adam-Fast	1.43e1	3.92e0	4.36e-2	1.86e1	49.9		
	GD	5.09e0	1.48e-1	4.75e0	5.31e0	32.5		
	GD-AdaptiveMomentum	4.60e1	6.15e0	3.36e1	5.66e1	20.6		
	GD-Momentum	3.55e1	8.91e0	1.96e1	4.95e1	20.8		
IllConditionedRosenbrock_10D_alpha100	**QQN-GoldenSection**	4.56e0	1.82e0	4.63e-1	6.66e0	4477.5		
	QQN-CubicQuadraticInterpolation	6.00e-1	1.52e0	1.13e-7	4.99e0	1666.2		
	Adam-AMSGrad	9.31e0	3.61e-1	8.08e0	9.69e0	2490.9		
	Adam-Robust	3.49e1	9.88e0	1.61e1	5.15e1	2502.0		
	QQN-StrongWolfe	5.85e-1	1.24e0	9.35e-8	4.79e0	1847.0		
	GD-Nesterov	1.17e0	1.66e-2	1.12e0	1.19e0	1514.9		
	Adam	9.11e0	4.86e-1	7.98e0	9.93e0	2475.8		
	L-BFGS-MoreThuente	3.41e0	3.98e0	3.35e-5	1.75e1	2853.3		
	QQN-Bisection-1	1.22e0	2.80e0	1.19e-7	9.52e0	1844.9		
	L-BFGS-Aggressive	1.64e2	3.20e2	5.82e1	1.56e3	3850.3		
	L-BFGS-Limited	3.86e0	5.50e-1	2.71e0	5.45e0	4036.8		
	Adam-WeightDecay	2.38e0	4.13e0	6.46e-6	9.61e0	2074.9		
	GD-WeightDecay	1.34e0	1.81e0	1.70e-1	5.25e0	1217.3		
	QQN-Bisection-2	4.40e0	1.40e0	1.07e-7	5.50e0	1646.8		
	L-BFGS-Conservative	1.90e4	6.07e4	1.03e0	2.56e5	3278.5		
	Trust Region-Adaptive	2.02e3	2.22e2	1.64e3	2.59e3	3002.0		
	Trust Region-Conservative	2.16e3	2.33e2	1.76e3	2.55e3	3002.0		
	Trust Region-Standard	1.06e3	2.06e2	6.70e2	1.41e3	3002.0		
	Trust Region-Precise	2.10e3	1.92e2	1.66e3	2.46e3	3002.0		
	GD-Momentum	3.04e1	3.31e1	5.05e-1	7.27e1	517.6		
	Trust Region-Aggressive	6.55e1	2.02e2	9.60e0	9.28e2	1618.0		
	L-BFGS	1.19e2	1.68e2	2.51e1	7.37e2	338.9		
	Adam-Fast	1.53e1	1.47e1	1.91e-1	3.68e1	149.2		
	GD	9.96e0	2.61e-1	9.64e0	1.05e1	46.6		
	GD-AdaptiveMomentum	1.02e2	9.83e0	8.45e1	1.16e2	23.1		

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
Trigonometric_2D	**Adam-AMSGrad**	1.08e-6	3.54e-7	9.47e-7	2.57e-6	1241.2			
	Adam	9.77e-7	1.59e-8	9.40e-7	9.98e-7	1269.5			
	Adam-Robust	3.10e-3	1.20e-2	5.08e-7	5.56e-2	442.4			
	GD	9.80e-7	1.07e-8	9.61e-7	9.99e-7	361.1			
	L-BFGS-Aggressive	3.62e-4	1.35e-3	7.20e-8	6.20e-3	843.0			
	Adam-WeightDecay	1.76e-5	4.01e-5	3.77e-7	1.63e-4	362.9			
	L-BFGS-Limited	7.02e-6	2.23e-5	2.15e-8	1.00e-4	433.9			
	QQN-GoldenSection	1.28e-3	5.56e-3	6.12e-10	2.55e-2	462.6			
	QQN-Bisection-2	2.06e-7	2.73e-7	7.96e-10	8.24e-7	207.1			
	QQN-Bisection-1	2.08e-7	2.21e-7	1.49e-9	7.99e-7	220.8			
	QQN-StrongWolfe	4.90e-7	2.12e-7	2.93e-9	9.96e-7	107.8			
	GD-WeightDecay	2.11e-4	6.48e-4	8.75e-7	2.81e-3	102.4			
	QQN-CubicQuadraticInterpolation	3.11e-7	3.76e-7	6.47e-10	9.84e-7	95.8			
	L-BFGS-Conservative	5.22e-7	2.95e-7	3.92e-8	9.76e-7	129.4			
	L-BFGS	4.06e-3	1.77e-2	8.58e-10	8.12e-2	93.3			
	L-BFGS-MoreThuente	4.44e-7	3.28e-7	1.25e-8	9.94e-7	85.4			
	Adam-Fast	6.08e-3	1.20e-2	1.89e-8	5.66e-2	47.6			
	GD-AdaptiveMomentum	7.65e-3	4.04e-3	5.90e-5	1.24e-2	23.2			
	GD-Nesterov	2.31e-2	2.66e-2	5.79e-4	7.14e-2	24.2			
	GD-Momentum	3.43e-2	2.95e-2	2.30e-4	8.79e-2	22.1			
	Trust Region-Conservative	8.94e-3	1.37e-2	1.87e-3	4.88e-2	43.2			
	Trust Region-Aggressive	2.50e1	1.94e1	3.36e-2	5.71e1	18.3			
	Trust Region-Precise	1.11e-1	2.96e-1	1.34e-2	1.39e0	16.8			
	Trust Region-Standard	1.22e1	2.59e1	2.19e-1	9.57e1	13.5			
	Trust Region-Adaptive	8.77e0	2.18e1	1.18e-2	8.47e1	12.8			
Trigonometric_5D	**Adam-AMSGrad**	2.94e-2	3.49e-2	9.71e-7	8.56e-2	2192.1			
	QQN-StrongWolfe	7.54e-7	4.98e-7	1.51e-8	1.93e-6	1274.7			
	Adam	1.12e-2	2.74e-2	8.42e-7	8.54e-2	1728.1			
	L-BFGS-Aggressive	1.22e0	5.81e-1	1.48e-1	2.56e0	3851.9			
	Adam-Robust	1.43e-2	2.36e-2	2.34e-7	6.11e-2	978.1			
	L-BFGS-MoreThuente	5.44e-4	2.01e-3	1.15e-7	9.19e-3	1087.8			
	QQN-GoldenSection	2.34e-7	2.85e-7	3.03e-9	8.60e-7	1123.5			
	L-BFGS-Limited	2.14e-3	9.31e-3	7.20e-7	4.27e-2	1331.0			
	Adam-WeightDecay	1.95e-2	3.08e-2	3.70e-7	8.53e-2	784.6			
	QQN-CubicQuadraticInterpolation	4.16e-7	3.74e-7	1.09e-9	9.80e-7	389.1			
	QQN-Bisection-1	8.71e-4	3.70e-3	1.72e-10	1.70e-2	664.0			
	L-BFGS-Conservative	2.73e-3	1.19e-2	1.66e-7	5.45e-2	887.4			
	GD	9.83e-7	7.74e-9	9.62e-7	9.94e-7	399.2			
	QQN-Bisection-2	3.22e-7	3.08e-7	6.17e-10	9.20e-7	305.6			
	GD-WeightDecay	1.36e-2	2.77e-2	8.18e-7	8.54e-2	105.4			
	L-BFGS	4.77e0	8.95e0	1.26e-2	4.30e1	233.9			
	Trust Region-Conservative	1.91e-2	1.87e-2	8.29e-4	5.63e-2	425.6			
	Adam-Fast	6.17e-2	5.21e-2	7.00e-4	1.62e-1	54.8			
	GD-Nesterov	1.60e-2	2.60e-2	4.85e-4	7.53e-2	33.5			
	GD-AdaptiveMomentum	1.79e-2	3.35e-2	1.30e-4	1.56e-1	30.6			
	GD-Momentum	1.57e-1	1.93e-1	4.87e-3	8.47e-1	25.0			
	Trust Region-Precise	5.59e-2	2.09e-2	1.47e-2	9.38e-2	84.8			
	Trust Region-Adaptive	1.25e-1	7.39e-2	2.86e-2	3.04e-1	26.1			
	Trust Region-Standard	4.09e-1	1.81e-1	1.21e-1	7.66e-1	9.8			
	Trust Region-Aggressive	1.41e0	4.40e-1	6.56e-1	2.25e0	5.2			
Trigonometric_10D	**Adam-AMSGrad**	3.00e-2	3.66e-2	7.20e-6	8.75e-2	2502.0			
	L-BFGS-Limited	7.31e-3	1.99e-2	9.82e-6	8.19e-2	3943.6			
	Adam-Robust	7.13e-2	1.09e-1	9.71e-7	5.20e-1	1825.9			
	Adam	9.70e-2	2.10e-1	9.68e-7	7.20e-1	2080.5			
	L-BFGS-MoreThuente	1.34e-2	3.73e-2	4.78e-7	1.60e-1	1949.3			
	L-BFGS-Conservative	9.45e0	4.12e1	7.52e-7	1.89e2	3123.2			
	QQN-GoldenSection	4.35e-4	1.06e-3	1.12e-7	3.88e-3	1834.2			
	GD	4.39e-3	1.89e-2	9.77e-7	8.69e-2	958.0			
	L-BFGS-Aggressive	1.00e1	4.32e0	2.42e0	1.75e1	3852.0			
	Trust Region-Conservative	1.22e0	1.60e0	3.82e-3	5.77e0	2651.3			
	QQN-Bisection-1	7.53e-4	2.61e-3	2.91e-8	1.18e-2	858.0			
	Adam-WeightDecay	4.25e-2	1.14e-1	8.69e-7	5.20e-1	803.8			
	QQN-CubicQuadraticInterpolation	4.48e-7	2.76e-7	9.99e-9	9.71e-7	329.2			
	QQN-StrongWolfe	2.92e-7	2.02e-7	9.27e-9	7.23e-7	347.3			
	QQN-Bisection-2	3.56e-7	2.58e-7	8.26e-8	9.59e-7	357.8			
	GD-WeightDecay	8.48e-3	2.56e-2	8.63e-7	1.07e-1	134.4			
	Trust Region-Precise	1.07e-1	6.92e-2	2.28e-2	2.53e-1	455.3			
	Adam-Fast	6.24e-2	9.50e-2	2.65e-4	3.60e-1	102.7			

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
	GD-AdaptiveMomentum	1.41e-1	7.60e-2	4.06e-2	3.86e-1	48.0		
	GD-Nesterov	1.85e-1	7.94e-2	7.60e-2	4.35e-1	45.1		
	GD-Momentum	1.17e0	1.48e0	2.40e-3	4.14e0	34.0		
	Trust Region-Adaptive	1.86e-1	1.19e-1	2.37e-2	4.38e-1	118.4		
	L-BFGS	4.76e1	6.11e1	8.87e0	2.11e2	77.5		
	Trust Region-Standard	6.02e-1	2.65e-1	1.37e-1	1.10e0	34.1		
	Trust Region-Aggressive	1.90e0	5.88e-1	9.79e-1	3.67e0	12.2		
PenaltyI_2D_alpha1e6	**QQN-StrongWolfe**	1.14e0	1.65e-2	1.12e0	1.19e0	3162.1		
	L-BFGS-Aggressive	4.69e4	1.12e5	1.17e0	3.51e5	2664.3		
	QQN-GoldenSection	1.13e0	1.00e-4	1.12e0	1.13e0	2567.9		
	L-BFGS-MoreThuente	4.78e0	2.66e0	1.18e0	8.48e0	2878.8		
	QQN-Bisection-1	1.12e0	8.85e-7	1.12e0	1.13e0	1032.0		
	L-BFGS-Limited	1.18e0	5.23e-2	1.13e0	1.31e0	4341.4		
	Trust Region-Aggressive	1.39e5	7.17e4	1.23e4	2.70e5	3002.0		
	Trust Region-Conservative	1.39e5	8.98e4	8.35e3	4.03e5	3002.0		
	Trust Region-Standard	1.43e5	8.01e4	3.60e4	3.21e5	3002.0		
	Trust Region-Adaptive	1.32e5	8.14e4	1.57e4	3.15e5	3002.0		
	Trust Region-Precise	1.67e5	7.86e4	2.57e4	2.92e5	3002.0		
	Adam-AMSGrad	1.16e0	5.02e-2	1.13e0	1.35e0	647.9		
	L-BFGS-Conservative	1.13e0	2.13e-2	1.12e0	1.22e0	1183.8		
	Adam	1.17e0	1.42e-1	1.13e0	1.79e0	625.9		
	QQN-Bisection-2	2.42e0	1.73e0	1.17e0	6.97e0	299.3		
	Adam-WeightDecay	1.59e0	9.85e-1	1.14e0	4.57e0	226.2		
	Adam-Robust	2.11e0	2.17e0	1.13e0	1.02e1	107.1		
	L-BFGS	7.22e4	1.26e5	1.52e0	3.42e5	109.5		
	QQN-CubicQuadraticInterpolation	1.12e0	2.16e-16	1.12e0	1.12e0	38.0		
	GD-AdaptiveMomentum	7.74e2	1.18e3	1.15e0	3.84e3	17.6		
	Adam-Fast	1.01e2	2.80e2	1.26e0	1.09e3	22.0		
	GD-Nesterov	1.46e2	3.37e2	1.38e0	1.23e3	13.9		
	GD-WeightDecay	5.08e0	1.33e1	1.34e0	6.31e1	13.2		
	GD	1.37e1	3.13e1	1.28e0	1.22e2	14.9		
	GD-Momentum	6.67e1	2.53e2	1.26e0	1.16e3	13.0		
PenaltyI_5D_alpha1e6	**QQN-StrongWolfe**	4.21e0	1.19e0	2.86e0	7.74e0	3121.1		
	QQN-Bisection-1	2.81e0	6.12e-4	2.81e0	2.81e0	2178.7		
	QQN-GoldenSection	2.81e0	7.61e-5	2.81e0	2.81e0	3026.4		
	L-BFGS-Limited	2.96e0	9.11e-2	2.84e0	3.13e0	4259.2		
	L-BFGS-MoreThuente	1.29e1	4.81e0	3.57e0	1.92e1	2860.6		
	L-BFGS-Conservative	2.85e0	5.01e-2	2.81e0	3.03e0	3087.5		
	L-BFGS-Aggressive	2.82e5	2.24e5	3.49e0	6.03e5	1110.7		
	Trust Region-Conservative	3.90e5	1.18e5	1.47e5	5.82e5	3002.0		
	Trust Region-Aggressive	3.61e5	1.19e5	1.76e5	5.61e5	3002.0		
	Trust Region-Precise	4.20e5	1.11e5	2.36e5	6.26e5	3002.0		
	Trust Region-Standard	3.74e5	1.32e5	1.16e5	7.18e5	3002.0		
	Trust Region-Adaptive	3.71e5	1.47e5	9.78e4	6.40e5	3002.0		
	Adam-AMSGrad	2.85e0	9.04e-2	2.82e0	3.24e0	747.3		
	Adam	2.90e0	1.17e-1	2.82e0	3.24e0	733.5		
	QQN-Bisection-2	1.03e1	5.36e0	3.91e0	2.42e1	469.8		
	Adam-WeightDecay	7.65e0	7.96e0	2.86e0	3.08e1	260.1		
	Adam-Robust	2.16e1	2.85e1	2.82e0	1.26e2	120.4		
	L-BFGS	7.00e4	1.12e5	4.88e0	5.16e5	95.2		
	QQN-CubicQuadraticInterpolation	2.81e0	7.09e-16	2.81e0	2.81e0	38.0		
	Adam-Fast	4.69e2	8.74e2	3.30e0	2.81e3	29.0		
	GD-AdaptiveMomentum	5.87e2	9.45e2	3.36e0	2.82e3	13.9		
	GD-WeightDecay	3.50e1	9.28e1	3.50e0	4.19e2	14.5		
	GD	8.04e1	1.22e2	3.17e0	4.27e2	17.1		
	GD-Nesterov	3.89e2	8.55e2	3.28e0	3.56e3	14.1		
	GD-Momentum	9.24e1	2.66e2	3.99e0	1.22e3	14.4		
PenaltyI_10D_alpha1e6	**QQN-StrongWolfe**	1.10e1	3.01e0	8.12e0	2.06e1	3057.8		
	QQN-GoldenSection	5.63e0	1.88e-4	5.62e0	5.63e0	4382.9		
	QQN-Bisection-1	5.63e0	2.30e-3	5.63e0	5.63e0	2161.3		
	L-BFGS-Limited	5.89e0	1.07e-1	5.78e0	6.13e0	4213.4		
	L-BFGS-Conservative	5.73e0	1.30e-1	5.63e0	6.12e0	2611.7		
	L-BFGS-MoreThuente	2.89e1	6.69e0	1.06e1	3.74e1	2859.4		
	QQN-Bisection-2	1.86e1	5.50e0	9.12e0	2.63e1	1070.2		
	Trust Region-Adaptive	7.20e5	1.83e5	3.49e5	1.14e6	3002.0		
	Trust Region-Standard	7.40e5	2.39e5	2.96e5	1.19e6	3002.0		
	Trust Region-Conservative	7.72e5	1.26e5	5.48e5	1.03e6	3002.0		
	Trust Region-Precise	7.75e5	1.73e5	4.16e5	9.96e5	3002.0		

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
	Trust Region-Aggressive	7.20e5	1.73e5	3.91e5	1.04e6	3002.0		
	Adam-AMSGrad	5.66e0	1.39e-2	5.64e0	5.69e0	761.0		
	Adam	5.68e0	4.13e-2	5.64e0	5.80e0	764.5		
	Adam-WeightDecay	9.99e0	6.96e0	5.72e0	3.69e1	274.1		
	Adam-Robust	2.18e1	1.43e1	5.69e0	4.63e1	129.1		
	L-BFGS	1.71e5	2.52e5	8.62e0	6.62e5	101.3		
	Adam-Fast	1.17e3	2.05e3	6.26e0	8.05e3	42.3		
	QQN-CubicQuadraticInterpolation	5.62e0	1.32e-15	5.62e0	5.62e0	38.0		
	GD	6.02e0	3.78e-2	5.96e0	6.11e0	19.4		
	GD-AdaptiveMomentum	1.60e2	3.35e2	7.22e0	1.11e3	15.0		
	GD-WeightDecay	6.01e1	1.13e2	6.73e0	4.89e2	15.8		
	L-BFGS-Aggressive	7.30e5	1.81e5	2.94e5	1.04e6	11.0		
	GD-Nesterov	4.81e2	6.94e2	6.89e0	2.37e3	14.9		
	GD-Momentum	2.58e2	6.61e2	7.18e0	3.05e3	15.4		
Barrier_2D_mu0.1	**Adam-Robust**	4.09e-1	7.17e-3	4.00e-1	4.27e-1	2502.0		
	Adam-AMSGrad	4.13e-1	1.06e-2	4.01e-1	4.31e-1	2502.0		
	Adam	4.00e-1	1.38e-4	4.00e-1	4.00e-1	2502.0		
	Adam-WeightDecay	4.00e-1	2.27e-9	4.00e-1	4.00e-1	1498.4		
	L-BFGS-Conservative	4.00e-1	5.47e-8	4.00e-1	4.00e-1	880.4		
	GD	4.00e-1	2.64e-11	4.00e-1	4.00e-1	292.1		
	L-BFGS	4.00e-1	4.93e-10	4.00e-1	4.00e-1	163.9		
	L-BFGS-Limited	4.00e-1	1.29e-10	4.00e-1	4.00e-1	150.8		
	QQN-StrongWolfe	4.00e-1	4.20e-14	4.00e-1	4.00e-1	108.3		
	QQN-Bisection-2	4.00e-1	6.74e-15	4.00e-1	4.00e-1	125.5		
	Trust Region-Conservative	4.71e-1	7.74e-2	4.01e-1	6.13e-1	421.4		
	QQN-CubicQuadraticInterpolation	4.00e-1	1.10e-8	4.00e-1	4.00e-1	83.8		
	QQN-GoldenSection	4.00e-1	1.10e-9	4.00e-1	4.00e-1	144.2		
	QQN-Bisection-1	4.00e-1	2.90e-14	4.00e-1	4.00e-1	65.8		
	GD-WeightDecay	4.00e-1	6.36e-6	4.00e-1	4.00e-1	49.0		
	L-BFGS-Aggressive	4.00e-1	1.15e-15	4.00e-1	4.00e-1	65.7		
	GD-Momentum	5.05e-1	2.44e-2	4.82e-1	5.80e-1	20.9		
	Adam-Fast	5.15e-1	2.22e-2	4.74e-1	5.54e-1	31.4		
	GD-Nesterov	5.03e-1	1.17e-2	4.85e-1	5.26e-1	20.4		
	Trust Region-Precise	4.72e-1	1.30e-1	4.07e-1	8.14e-1	72.3		
	Trust Region-Adaptive	5.15e-1	1.22e-1	4.42e-1	7.59e-1	6.2		
	Trust Region-Aggressive	1.50e0	5.56e-1	5.85e-1	2.09e0	5.0		
	GD-AdaptiveMomentum	4.65e-1	4.95e-3	4.60e-1	4.70e-1	1.6		
	Trust Region-Standard	5.57e-1	6.39e-2	4.86e-1	6.42e-1	2.8		
Barrier_5D_mu0.1	**Adam-AMSGrad**	1.03e0	1.71e-2	1.01e0	1.07e0	2502.0		
	Adam-Robust	1.01e0	4.00e-3	1.00e0	1.01e0	2502.0		
	Adam	9.99e-1	9.02e-6	9.99e-1	9.99e-1	2502.0		
	Adam-WeightDecay	9.99e-1	2.90e-9	9.99e-1	9.99e-1	1316.6		
	L-BFGS-Conservative	9.99e-1	6.66e-9	9.99e-1	9.99e-1	599.6		
	GD	9.99e-1	2.58e-11	9.99e-1	9.99e-1	304.1		
	Trust Region-Conservative	1.05e0	6.79e-2	1.00e0	1.18e0	984.2		
	L-BFGS-Limited	9.99e-1	1.63e-9	9.99e-1	9.99e-1	190.6		
	QQN-StrongWolfe	9.99e-1	4.30e-15	9.99e-1	9.99e-1	112.1		
	QQN-Bisection-2	9.99e-1	1.38e-16	9.99e-1	9.99e-1	126.0		
	QQN-CubicQuadraticInterpolation	9.99e-1	1.54e-8	9.99e-1	9.99e-1	78.7		
	QQN-GoldenSection	9.99e-1	6.83e-15	9.99e-1	9.99e-1	144.7		
	L-BFGS	9.99e-1	1.51e-11	9.99e-1	9.99e-1	89.1		
	QQN-Bisection-1	9.99e-1	3.83e-14	9.99e-1	9.99e-1	77.2		
	GD-WeightDecay	9.99e-1	1.40e-5	9.99e-1	9.99e-1	49.2		
	Trust Region-Precise	1.02e0	1.63e-2	1.01e0	1.07e0	143.6		
	L-BFGS-Aggressive	9.99e-1	3.84e-14	9.99e-1	9.99e-1	63.8		
	Adam-Fast	1.28e0	5.59e-2	1.19e0	1.40e0	31.7		
	GD-Nesterov	1.26e0	2.76e-2	1.22e0	1.30e0	20.4		
	GD-Momentum	1.37e0	9.02e-2	1.28e0	1.64e0	21.0		
	Trust Region-Adaptive	1.17e0	1.56e-1	1.03e0	1.37e0	28.0		
	Trust Region-Aggressive	1.99e0	2.18e-1	1.58e0	2.39e0	5.7		
	Trust Region-Standard	1.23e0	5.13e-2	1.14e0	1.30e0	5.5		
Barrier_10D_mu0.1	**Adam-Robust**	2.00e0	2.51e-3	2.00e0	2.01e0	2502.0		
	Adam-AMSGrad	2.04e0	1.32e-2	2.02e0	2.07e0	2502.0		
	Adam	2.00e0	4.64e-7	2.00e0	2.00e0	2502.0		
	Adam-WeightDecay	2.00e0	5.45e-9	2.00e0	2.00e0	1144.5		
	Trust Region-Conservative	2.06e0	5.79e-2	2.00e0	2.18e0	2239.1		
	L-BFGS-Conservative	2.00e0	1.04e-8	2.00e0	2.00e0	555.1		
	GD	2.00e0	4.28e-11	2.00e0	2.00e0	305.0		

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
	L-BFGS-Limited	2.00e0	5.46e-9	2.00e0	2.00e0	195.4		
	QQN-StrongWolfe	2.00e0	9.48e-15	2.00e0	2.00e0	112.0		
	QQN-Bisection-2	2.00e0	5.70e-16	2.00e0	2.00e0	126.0		
	Trust Region-Precise	2.05e0	8.86e-2	2.00e0	2.37e0	326.6		
	QQN-CubicQuadraticInterpolation	2.00e0	1.07e-9	2.00e0	2.00e0	83.8		
	QQN-GoldenSection	2.00e0	2.17e-14	2.00e0	2.00e0	148.2		
	L-BFGS	2.00e0	5.81e-12	2.00e0	2.00e0	102.2		
	QQN-Bisection-1	2.00e0	6.18e-15	2.00e0	2.00e0	84.3		
	GD-WeightDecay	2.00e0	1.69e-5	2.00e0	2.00e0	49.4		
	L-BFGS-Aggressive	2.00e0	4.97e-14	2.00e0	2.00e0	62.2		
	Adam-Fast	2.58e0	8.67e-2	2.45e0	2.71e0	31.5		
	GD-Nesterov	2.50e0	4.65e-2	2.43e0	2.64e0	21.1		
	GD-Momentum	3.39e0	2.40e-1	2.91e0	3.84e0	21.2		
	Trust Region-Adaptive	2.28e0	8.56e-2	2.05e0	2.37e0	54.1		
	Trust Region-Standard	2.23e0	7.54e-2	2.11e0	2.30e0	9.4		
	Trust Region-Aggressive	3.00e0	3.10e-1	2.33e0	3.34e0	8.0		
NoisySphere_2D_sigma0.01	**QQN-Bisection-1**	1.33e0	6.30e-1	2.16e-1	2.48e0	41.2		
	L-BFGS-Conservative	1.57e0	7.01e-2	1.46e0	1.66e0	97.0		
	Adam-WeightDecay	2.18e0	2.38e-1	1.76e0	2.70e0	27.6		
	Adam-AMSGrad	2.10e0	2.73e-1	1.65e0	2.60e0	25.7		
	Adam	2.13e0	2.38e-1	1.72e0	2.60e0	21.4		
	QQN-StrongWolfe	9.23e-1	6.21e-1	2.83e-2	2.06e0	30.5		
	Adam-Robust	2.10e0	2.43e-1	1.76e0	2.74e0	16.9		
	L-BFGS	1.02e1	1.19e1	7.26e-2	3.76e1	33.2		
	L-BFGS-MoreThuente	1.84e0	7.24e-1	1.12e-1	2.67e0	18.7		
	QQN-GoldenSection	2.04e0	2.79e-1	1.45e0	2.45e0	27.1		
	L-BFGS-Limited	1.64e0	6.02e-1	7.63e-1	2.63e0	31.4		
	GD	2.20e0	6.02e-1	1.42e0	2.96e0	8.9		
	Adam-Fast	2.26e0	7.44e-1	1.40e0	4.41e0	12.3		
	QQN-CubicQuadraticInterpolation	2.04e0	2.13e-1	1.70e0	2.34e0	9.2		
	GD-Nesterov	2.82e0	9.93e-1	1.53e0	4.52e0	7.0		
	GD-WeightDecay	2.30e0	5.19e-1	1.61e0	3.10e0	6.8		
	GD-AdaptiveMomentum	2.39e0	7.39e-1	1.45e0	3.76e0	6.6		
	GD-Momentum	2.45e0	8.96e-1	1.43e0	4.08e0	6.8		
	L-BFGS-Aggressive	2.05e0	2.75e-1	1.69e0	2.57e0	5.5		
	Trust Region-Precise	2.19e0	2.25e-1	1.76e0	2.54e0	5.3		
	Trust Region-Conservative	2.06e0	2.96e-1	1.68e0	2.87e0	5.0		
	Trust Region-Aggressive	2.09e0	2.18e-1	1.70e0	2.50e0	4.2		
	Trust Region-Adaptive	2.03e0	2.74e-1	1.67e0	2.62e0	4.2		
	Trust Region-Standard	2.10e0	2.61e-1	1.70e0	2.64e0	4.0		
	QQN-Bisection-2	1.97e0	7.03e-3	1.96e0	1.97e0	2.4		
NoisySphere_5D_sigma0.01	**QQN-Bisection-1**	4.46e0	9.06e-1	2.43e0	6.17e0	75.7		
	L-BFGS-Conservative	4.42e0	1.19e-1	4.14e0	4.57e0	120.3		
	Adam	5.42e0	2.68e-1	4.73e0	5.93e0	26.1		
	Adam-AMSGrad	5.42e0	3.72e-1	4.94e0	6.37e0	18.6		
	Adam-Robust	5.11e0	3.42e-1	4.60e0	5.73e0	17.1		
	L-BFGS	1.44e1	8.91e0	2.91e0	3.12e1			
	Adam-WeightDecay	5.22e0	3.07e-1	4.62e0	5.81e0			
	GD	5.52e0	8.70e-1	4.36e0	6.84e0			
	Adam-Fast	5.99e0	1.16e0	4.17e0	8.14e0			
	GD-Momentum	5.71e0	9.79e-1	4.41e0	7.61e0			
	L-BFGS-Limited	3.90e0	8.53e-1	2.63e0	5.48e0			
	GD-AdaptiveMomentum	5.68e0	8.70e-1	4.36e0	7.22e0			
	GD-Nesterov	5.61e0	1.00e0	4.26e0	6.77e0			
	L-BFGS-MoreThuente	4.61e0	8.49e-1	3.27e0	5.99e0			
	GD-WeightDecay	5.35e0	6.50e-1	4.47e0	6.45e0			
	QQN-StrongWolfe	3.67e0	1.35e0	1.11e0	5.33e0			
	QQN-GoldenSection	4.88e0	7.47e-1	3.49e0	6.27e0			
	QQN-CubicQuadraticInterpolation	5.26e0	3.22e-1	4.75e0	5.60e0			
	Trust Region-Precise	5.28e0	4.50e-1	4.65e0	6.08e0			
	Trust Region-Conservative	5.20e0	3.98e-1	4.59e0	5.78e0			
	Trust Region-Standard	5.20e0	3.94e-1	4.73e0	6.28e0			
	Trust Region-Aggressive	5.27e0	3.43e-1	4.65e0	5.82e0			
	Trust Region-Adaptive	5.32e0	3.69e-1	4.65e0	6.03e0			
	L-BFGS-Aggressive	5.18e0	4.15e-1	4.66e0	5.74e0			
NoisySphere_10D_sigma0.01	**QQN-Bisection-1**	9.08e0	1.54e0	4.69e0	1.10e1			
	L-BFGS-Conservative	9.49e0	1.72e-1	9.16e0	9.70e0			
	Adam-WeightDecay	1.04e1	4.40e-1	9.79e0	1.14e1			

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Adam-AMSGrad	1.04e1	6.28e-1	9.75e0	1.18e1				
	Adam	1.07e1	5.64e-1	9.87e0	1.20e1				
	Adam-Robust	1.05e1	6.12e-1	9.71e0	1.19e1				
	GD	1.10e1	7.03e-1	9.54e0	1.19e1				
	GD-AdaptiveMomentum	1.03e1	7.39e-1	9.45e0	1.20e1				
	L-BFGS	2.28e1	1.18e1	7.46e0	4.18e1				
	GD-Nesterov	1.09e1	8.10e-1	9.63e0	1.25e1				
	L-BFGS-MoreThuente	9.77e0	1.48e0	6.61e0	1.14e1				
	GD-Momentum	1.11e1	9.34e-1	9.66e0	1.26e1				
	QQN-GoldenSection	1.03e1	5.55e-1	9.18e0	1.11e1				
	QQN-StrongWolfe	9.41e0	1.31e0	7.23e0	1.10e1				
	GD-WeightDecay	1.10e1	7.21e-1	9.66e0	1.25e1				
	Adam-Fast	1.11e1	1.47e0	9.46e0	1.54e1				
	L-BFGS-Limited	9.06e0	1.17e0	6.79e0	1.08e1				
	Trust Region-Conservative	1.04e1	3.84e-1	9.82e0	1.13e1				
	Trust Region-Precise	1.06e1	3.31e-1	9.93e0	1.12e1				
	L-BFGS-Aggressive	1.06e1	5.02e-1	9.75e0	1.11e1				
	Trust Region-Aggressive	1.04e1	5.45e-1	9.77e0	1.14e1				
	Trust Region-Standard	1.06e1	5.93e-1	9.80e0	1.16e1				
	QQN-CubicQuadraticInterpolation	1.04e1	1.61e-1	1.03e1	1.07e1				
	Trust Region-Adaptive	1.04e1	6.06e-1	9.73e0	1.17e1				
SparseRosenbrock_4D	**QQN-GoldenSection**	3.33e-1	1.76e-1	6.04e-7	6.84e-1	4			
	QQN-StrongWolfe	3.39e-1	6.28e-1	2.24e-8	3.00e0	2			
	QQN-CubicQuadraticInterpolation	5.85e-2	6.41e-2	6.10e-9	2.15e-1	1			
	QQN-Bisection-1	4.56e-1	4.62e-1	9.12e-8	1.60e0	2			
	Adam-AMSGrad	3.39e0	1.45e0	1.65e0	8.86e0	2			
	Adam	2.06e0	4.83e-1	1.19e0	3.18e0	2			
	L-BFGS-MoreThuente	1.75e0	2.72e0	2.55e-7	8.30e0	2			
	L-BFGS-Limited	2.33e0	4.08e0	7.38e-2	1.74e1	3			
	L-BFGS-Conservative	1.27e2	5.46e2	3.78e-5	2.51e3	3			
	L-BFGS-Aggressive	6.34e1	4.42e1	8.59e0	1.72e2	3			
	Trust Region-Conservative	4.72e1	4.50e1	3.37e-1	1.58e2	2			
	Adam-WeightDecay	6.07e0	3.97e0	1.75e-2	9.30e0	8			
	Adam-Robust	7.53e0	1.96e0	3.60e0	8.99e0	6			
	GD	1.88e0	2.48e0	9.10e-1	9.50e0	5			
	Trust Region-Precise	2.16e1	2.75e1	7.75e0	1.10e2	1			
	Trust Region-Adaptive	8.31e0	2.62e-1	7.78e0	8.82e0	9			
	Adam-Fast	1.92e0	3.76e0	1.14e-3	1.01e1	2			
	QQN-Bisection-2	1.42e0	1.80e0	5.00e-7	3.95e0	1			
	GD-WeightDecay	3.04e0	4.49e0	4.73e-2	1.17e1	1			
	L-BFGS	9.62e1	1.12e2	7.18e0	4.84e2	1			
	GD-Nesterov	3.38e0	3.99e0	1.58e-1	1.22e1				
	GD-AdaptiveMomentum	1.31e0	4.23e0	2.41e-2	1.97e1				
	Trust Region-Standard	8.25e0	2.76e-1	7.68e0	8.68e0	1			
	GD-Momentum	1.10e1	6.57e0	4.39e-2	3.10e1				
	Trust Region-Aggressive	8.72e0	4.61e-1	7.92e0	9.65e0				
SparseRosenbrock_10D	**QQN-GoldenSection**	5.84e-1	5.22e-1	5.69e-7	2.38e0	4			
	QQN-StrongWolfe	5.37e-1	7.63e-1	1.90e-9	3.16e0	2			
	QQN-CubicQuadraticInterpolation	1.42e-1	1.61e-1	1.89e-8	3.94e-1	1			
	QQN-Bisection-1	6.70e-1	9.09e-1	1.26e-7	3.85e0	2			
	Adam-AMSGrad	5.73e0	9.36e-1	4.14e0	7.62e0	2			
	Adam-Robust	1.19e1	2.30e0	9.15e0	2.07e1	2			
	Adam	4.91e0	1.16e0	3.14e0	7.20e0	2			
	L-BFGS-MoreThuente	7.68e0	8.03e0	2.91e-4	2.32e1	2			
	L-BFGS-Limited	1.28e0	3.17e0	3.17e-1	1.51e1	3			
	Adam-WeightDecay	3.27e0	7.74e0	1.06e-2	2.19e1	2			
	L-BFGS-Conservative	1.05e7	4.58e7	2.96e-2	2.10e8	3			
	L-BFGS-Aggressive	1.81e2	7.47e1	8.09e1	4.01e2	3			
	QQN-Bisection-2	3.21e0	5.76e0	3.42e-1	1.61e1	8			
	Trust Region-Conservative	1.56e2	4.85e1	6.91e1	2.68e2	3			
	Trust Region-Precise	1.04e2	6.99e1	1.18e0	2.43e2	3			
	Trust Region-Adaptive	2.92e1	2.81e1	2.02e1	1.48e2	2			
	GD	3.27e0	5.80e0	1.20e0	2.11e1	3			
	Adam-Fast	1.90e0	5.64e0	5.27e-2	2.63e1	2			
	GD-WeightDecay	4.84e0	9.20e0	1.18e-1	2.47e1	1			
	Trust Region-Standard	2.05e1	3.97e-1	1.95e1	2.11e1	4			
	GD-Nesterov	7.90e-1	5.92e-1	5.84e-2	2.48e0	1			
	L-BFGS	2.80e2	3.25e2	2.70e1	1.32e3	1			

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	GD-AdaptiveMomentum	1.31e1	1.44e1	5.08e-2	3.27e1				
	Trust Region-Aggressive	2.11e1	8.10e-1	1.97e1	2.26e1	1			
	GD-Momentum	3.15e1	1.33e1	3.12e-1	4.42e1				
SparseQuadratic_5D_pattern[1, 3]	**Adam-AMSGrad**	1.95e-1	5.56e-2	1.19e-1	3.19e-1	2			
	Adam-Robust	6.93e-2	2.46e-2	2.83e-2	1.11e-1	2			
	Adam	3.67e-3	1.54e-3	5.91e-4	5.76e-3	2			
	Adam-WeightDecay	9.85e-7	7.96e-9	9.73e-7	9.99e-7	1			
	Trust Region-Conservative	4.06e0	2.02e0	8.95e-3	5.15e0	1			
	GD	9.77e-7	1.24e-8	9.59e-7	9.96e-7	3			
	L-BFGS-Conservative	2.84e-7	3.62e-7	1.15e-10	9.31e-7	3			
	GD-WeightDecay	9.21e-7	4.76e-8	8.42e-7	9.96e-7				
	L-BFGS-Limited	4.57e-7	2.77e-7	4.26e-9	9.93e-7	1			
	Trust Region-Precise	4.92e-1	5.29e-1	3.14e-2	1.49e0	3			
	QQN-GoldenSection	1.09e-7	1.38e-7	2.49e-9	4.81e-7	1			
	QQN-CubicQuadraticInterpolation	4.31e-7	3.85e-8	3.60e-7	4.92e-7				
	QQN-Bisection-1	1.79e-7	2.00e-7	4.95e-9	7.40e-7				
	L-BFGS	4.77e-7	3.20e-7	1.77e-8	9.73e-7				
	QQN-Bisection-2	1.58e-7	2.16e-7	1.83e-9	7.77e-7				
	Adam-Fast	3.56e-1	1.39e-2	3.36e-1	3.82e-1				
	GD-Nesterov	3.19e-1	3.40e-2	2.73e-1	3.98e-1				
	GD-AdaptiveMomentum	9.75e-1	6.24e-2	8.63e-1	1.09e0				
	Trust Region-Adaptive	1.23e3	4.09e2	5.86e-2	1.37e3				
	GD-Momentum	5.03e-1	4.96e-2	4.06e-1	6.07e-1				
	QQN-StrongWolfe	2.22e-7	1.26e-7	4.00e-8	4.52e-7				
	L-BFGS-Aggressive	2.84e-7	3.06e-8	2.36e-7	3.36e-7				
	L-BFGS-MoreThuente	8.81e-8	1.36e-7	1.12e-8	6.56e-7				
	Trust Region-Standard	1.81e2	7.08e0	1.67e2	1.90e2				
	Trust Region-Aggressive	1.82e4	7.17e2	1.51e4	1.86e4				
SparseQuadratic_10D_pattern[1, 3]	**Adam-Robust**	1.03e-1	3.53e-2	4.23e-2	1.71e-1	2			
	Adam-AMSGrad	2.33e-1	4.06e-2	1.70e-1	3.20e-1	2			
	Adam	2.03e-3	8.81e-4	3.96e-4	3.78e-3	2			
	Adam-WeightDecay	9.83e-7	7.84e-9	9.70e-7	9.98e-7	1			
	Trust Region-Conservative	1.83e0	5.92e-1	6.04e-1	3.15e0	3			
	GD	9.80e-7	1.20e-8	9.60e-7	1.00e-6	3			
	L-BFGS-Conservative	2.03e-7	2.96e-7	2.80e-9	9.97e-7	3			
	Trust Region-Precise	1.80e-1	3.28e-1	2.31e-3	1.54e0	5			
	GD-WeightDecay	9.31e-7	3.38e-8	8.75e-7	9.98e-7	1			
	QQN-GoldenSection	3.11e-7	3.27e-7	7.74e-9	9.91e-7	1			
	QQN-CubicQuadraticInterpolation	2.38e-8	1.47e-8	2.26e-9	4.52e-8				
	L-BFGS	1.93e-3	8.35e-3	1.06e-8	3.83e-2				
	Trust Region-Adaptive	1.28e3	4.25e2	5.42e-2	1.43e3	1			
	QQN-Bisection-1	5.68e-7	3.82e-7	2.29e-8	9.90e-7				
	L-BFGS-Limited	4.74e-7	2.74e-7	5.73e-8	9.57e-7				
	QQN-Bisection-2	3.81e-7	3.20e-7	2.03e-8	9.46e-7				
	QQN-StrongWolfe	2.19e-7	1.50e-7	8.82e-8	8.12e-7				
	Adam-Fast	7.28e-1	2.79e-2	6.71e-1	7.71e-1				
	GD-AdaptiveMomentum	1.57e0	4.23e-2	1.41e0	1.64e0				
	GD-Nesterov	6.03e-1	2.70e-2	5.68e-1	7.02e-1				
	GD-Momentum	9.15e-1	5.54e-2	8.60e-1	1.06e0				
	L-BFGS-Aggressive	2.16e-7	1.67e-8	1.72e-7	2.44e-7				
	Trust Region-Standard	1.02e2	3.48e1	2.21e-1	1.29e2				
	L-BFGS-MoreThuente	2.20e-7	2.42e-7	2.06e-8	8.82e-7				
	Trust Region-Aggressive	2.01e4	4.68e3	8.89e-1	2.17e4				
LogisticRegression_100samples_5features_reg0.01	**GD-WeightDecay**	3.27e-1	3.54e-4	3.26e-1	3.27e-1	1			
	GD-Nesterov	3.15e-1	3.66e-7	3.15e-1	3.15e-1	1			
	GD-Momentum	3.15e-1	3.78e-7	3.15e-1	3.15e-1	1			
	GD	3.77e-1	2.81e-3	3.72e-1	3.81e-1	1			
	Adam-Robust	4.32e-1	1.22e-2	4.13e-1	4.60e-1	2			
	Adam-AMSGrad	4.05e-1	9.76e-3	3.87e-1	4.23e-1	2			
	Adam-WeightDecay	3.22e-1	1.09e-3	3.20e-1	3.24e-1	2			
	Adam	4.02e-1	9.33e-3	3.92e-1	4.21e-1	2			
	L-BFGS-Limited	3.15e-1	1.97e-5	3.15e-1	3.15e-1	3			
	L-BFGS	3.16e-1	7.17e-4	3.15e-1	3.19e-1	2			
	L-BFGS-Aggressive	3.15e-1	1.24e-4	3.15e-1	3.16e-1	1			
	GD-AdaptiveMomentum	3.15e-1	4.41e-9	3.15e-1	3.15e-1	4			
	L-BFGS-Conservative	3.15e-1	5.83e-11	3.15e-1	3.15e-1	5			
	QQN-GoldenSection	3.15e-1	2.54e-12	3.15e-1	3.15e-1	3			
	QQN-Bisection-1	3.15e-1	2.67e-12	3.15e-1	3.15e-1				

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Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	QQN-CubicQuadraticInterpolation	3.15e-1	2.75e-12	3.15e-1	3.15e-1				
	L-BFGS-MoreThuente	3.15e-1	2.25e-5	3.15e-1	3.15e-1				
	Adam-Fast	3.16e-1	1.09e-4	3.16e-1	3.16e-1				
	QQN-Bisection-2	3.15e-1	2.84e-12	3.15e-1	3.15e-1				
	QQN-StrongWolfe	3.15e-1	2.43e-12	3.15e-1	3.15e-1				
	Trust Region-Conservative	4.24e-1	2.86e-3	4.20e-1	4.28e-1				
	Trust Region-Precise	6.78e-1	2.08e-2	6.48e-1	7.23e-1				
	Trust Region-Aggressive	6.98e-1	2.53e-2	6.53e-1	7.51e-1				
	Trust Region-Standard	6.98e-1	3.18e-2	6.55e-1	7.75e-1				
	Trust Region-Adaptive	6.95e-1	3.03e-2	6.37e-1	7.46e-1				
LogisticRegression_200samples_10features_reg0.01	**GD-WeightDecay**	3.39e-1	4.45e-4	3.38e-1	3.40e-1				
	GD-Nesterov	3.23e-1	6.77e-7	3.23e-1	3.23e-1				
	GD-Momentum	3.23e-1	7.07e-7	3.23e-1	3.23e-1				
	GD	3.97e-1	3.28e-3	3.93e-1	4.05e-1				
	Adam-WeightDecay	3.27e-1	8.69e-4	3.25e-1	3.29e-1				
	Adam-Robust	4.12e-1	8.61e-3	3.96e-1	4.28e-1				
	Adam-AMSGrad	3.95e-1	5.85e-3	3.84e-1	4.09e-1				
	Adam	3.92e-1	9.22e-3	3.75e-1	4.09e-1				
	L-BFGS-Limited	3.23e-1	8.38e-5	3.23e-1	3.24e-1				
	L-BFGS-Aggressive	3.25e-1	7.06e-4	3.23e-1	3.26e-1				
	L-BFGS	3.23e-1	2.14e-5	3.23e-1	3.23e-1				
	GD-AdaptiveMomentum	3.23e-1	4.50e-9	3.23e-1	3.23e-1				
	L-BFGS-Conservative	3.23e-1	9.68e-11	3.23e-1	3.23e-1				
	QQN-GoldenSection	3.23e-1	1.79e-12	3.23e-1	3.23e-1				
	QQN-Bisection-1	3.23e-1	1.05e-12	3.23e-1	3.23e-1				
	QQN-CubicQuadraticInterpolation	3.23e-1	1.34e-12	3.23e-1	3.23e-1				
	QQN-Bisection-2	3.23e-1	1.19e-12	3.23e-1	3.23e-1				
	QQN-StrongWolfe	3.23e-1	1.79e-12	3.23e-1	3.23e-1				
	Adam-Fast	3.24e-1	2.14e-4	3.24e-1	3.25e-1				
	L-BFGS-MoreThuente	3.23e-1	2.80e-4	3.23e-1	3.24e-1				
	Trust Region-Conservative	4.44e-1	2.76e-3	4.39e-1	4.49e-1				
	Trust Region-Precise	7.01e-1	2.67e-2	6.59e-1	7.56e-1				
	Trust Region-Adaptive	7.06e-1	2.50e-2	6.56e-1	7.48e-1				
	Trust Region-Standard	7.01e-1	2.90e-2	6.45e-1	7.53e-1				
	Trust Region-Aggressive	7.03e-1	2.08e-2	6.65e-1	7.53e-1				
LinearRegression_100samples_5features_reg0.01	**Adam-AMSGrad**	3.06e0	3.82e-1	2.47e0	3.69e0				
	Adam-Robust	4.89e0	5.55e-1	4.01e0	6.12e0				
	Adam	2.88e0	4.16e-1	2.36e0	3.78e0				
	Adam-WeightDecay	7.18e-2	1.52e-4	7.16e-2	7.21e-2				
	Trust Region-Conservative	7.87e0	9.98e-1	6.26e0	9.77e0				
	L-BFGS-Conservative	7.15e-2	3.25e-10	7.15e-2	7.15e-2				
	GD	7.15e-2	5.94e-11	7.15e-2	7.15e-2				
	L-BFGS-MoreThuente	7.16e-2	5.33e-5	7.15e-2	7.18e-2				
	Trust Region-Precise	1.38e-1	8.18e-2	7.38e-2	4.03e-1				
	L-BFGS-Limited	7.15e-2	2.22e-10	7.15e-2	7.15e-2				
	GD-WeightDecay	7.15e-2	2.05e-10	7.15e-2	7.15e-2				
	QQN-GoldenSection	7.15e-2	1.34e-9	7.15e-2	7.15e-2				
	Trust Region-Adaptive	1.55e3	6.64e2	1.22e-1	1.96e3				
	L-BFGS	1.38e-1	2.48e-1	7.15e-2	1.21e0				
	QQN-Bisection-1	7.15e-2	9.50e-15	7.15e-2	7.15e-2				
	QQN-CubicQuadraticInterpolation	7.15e-2	1.77e-9	7.15e-2	7.15e-2				
	QQN-StrongWolfe	7.15e-2	8.70e-14	7.15e-2	7.15e-2				
	QQN-Bisection-2	7.15e-2	3.89e-14	7.15e-2	7.15e-2				
	L-BFGS-Aggressive	7.15e-2	3.23e-14	7.15e-2	7.15e-2				
	Adam-Fast	1.90e-1	6.82e-2	7.25e-2	2.46e-1				
	Trust Region-Standard	1.10e2	5.00e1	2.92e-1	1.65e2				
	GD-Nesterov	9.19e-1	2.74e-2	8.36e-1	9.57e-1				
	GD-Momentum	1.36e0	6.13e-2	1.22e0	1.50e0				
	GD-AdaptiveMomentum	2.00e0	4.19e-2	1.90e0	2.04e0				
	Trust Region-Aggressive	3.62e4	1.65e4	9.10e-1	5.27e4				
LinearRegression_200samples_10features_reg0.01	**Adam-AMSGrad**	5.39e1	1.53e0	5.00e1	5.75e1				
	Adam-Robust	6.34e1	2.14e0	5.92e1	6.79e1				
	Adam-WeightDecay	2.42e0	4.49e-1	1.66e0	3.54e0				
	Adam	5.34e1	2.38e0	4.86e1	5.85e1				
	Trust Region-Precise	5.39e1	3.12e0	4.85e1	5.96e1				
	Trust Region-Conservative	1.06e2	1.88e0	1.03e2	1.10e2				
	Trust Region-Adaptive	1.08e3	8.92e2	5.40e-1	2.10e3				
	GD	4.82e-1	3.41e-6	4.82e-1	4.82e-1				

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	L-BFGS-Conservative	4.82e-1	2.33e-5	4.82e-1	4.82e-1				
	Trust Region-Standard	2.56e3	4.67e3	7.13e-1	1.23e4				
	Adam-Fast	5.14e-1	4.25e-2	4.82e-1	5.75e-1				
	GD-WeightDecay	4.82e-1	9.82e-6	4.82e-1	4.82e-1				
	L-BFGS-Aggressive	4.82e-1	2.65e-5	4.82e-1	4.82e-1				
	L-BFGS-Limited	4.82e-1	9.14e-5	4.82e-1	4.82e-1				
	QQN-Bisection-1	4.82e-1	1.93e-6	4.82e-1	4.82e-1				
	QQN-GoldenSection	4.82e-1	1.59e-5	4.82e-1	4.82e-1				
	Trust Region-Aggressive	3.92e4	2.34e4	1.28e0	6.10e4				
	QQN-Bisection-2	4.82e-1	1.86e-6	4.82e-1	4.82e-1				
	L-BFGS	5.09e-1	9.28e-2	4.82e-1	8.97e-1				
	QQN-StrongWolfe	4.82e-1	1.42e-5	4.82e-1	4.82e-1				
	L-BFGS-MoreThuente	4.82e-1	8.59e-5	4.82e-1	4.82e-1				
	GD-Momentum	2.46e0	2.68e-2	2.41e0	2.51e0				
	GD-Nesterov	1.80e0	1.42e-2	1.78e0	1.83e0				
	QQN-CubicQuadraticInterpolation	4.82e-1	2.65e-5	4.82e-1	4.82e-1				
	GD-AdaptiveMomentum	5.05e0	5.26e-2	4.95e0	5.12e0				
NeuralNetwork_100samples_layers_5_10_3	**GD-WeightDecay**	1.83e-1	4.09e-3	1.75e-1	1.92e-1				
	GD	2.01e-1	2.75e-3	1.95e-1	2.06e-1				
	Adam-Robust	1.69e-1	6.95e-3	1.49e-1	1.80e-1				
	Adam-AMSGrad	1.55e-1	7.51e-3	1.40e-1	1.67e-1				
	Adam	1.58e-1	6.21e-3	1.45e-1	1.68e-1				
	L-BFGS-MoreThuente	1.51e-1	6.61e-3	1.41e-1	1.64e-1				
	L-BFGS-Conservative	1.49e-1	8.52e-3	1.39e-1	1.71e-1				
	L-BFGS-Limited	1.48e-1	1.10e-2	1.40e-1	1.83e-1				
	L-BFGS-Aggressive	1.50e-1	6.91e-3	1.40e-1	1.63e-1				
	Adam-WeightDecay	1.43e-1	7.02e-3	1.40e-1	1.68e-1				
	QQN-StrongWolfe	1.43e-1	5.71e-3	1.39e-1	1.59e-1				
	QQN-Bisection-1	1.40e-1	1.77e-3	1.39e-1	1.47e-1				
	L-BFGS	2.01e-1	5.93e-2	1.40e-1	3.37e-1				
	QQN-GoldenSection	1.41e-1	3.80e-3	1.39e-1	1.55e-1				
	QQN-CubicQuadraticInterpolation	1.40e-1	1.86e-3	1.38e-1	1.46e-1				
	QQN-Bisection-2	1.40e-1	3.24e-3	1.38e-1	1.54e-1				
	Adam-Fast	1.40e-1	2.71e-3	1.38e-1	1.49e-1				
	Trust Region-Conservative	2.19e-1	2.52e-3	2.14e-1	2.24e-1				
	Trust Region-Adaptive	2.63e-1	9.37e-2	1.83e-1	4.96e-1				
	GD-Nesterov	2.27e-1	3.63e-3	2.19e-1	2.34e-1				
	GD-Momentum	2.35e-1	6.16e-3	2.26e-1	2.47e-1				
	Trust Region-Standard	4.50e-1	6.70e-1	1.89e-1	2.92e0				
	Trust Region-Precise	2.20e-1	5.66e-3	2.08e-1	2.30e-1				
	GD-AdaptiveMomentum	2.59e-1	1.32e-2	2.33e-1	2.85e-1				
	Trust Region-Aggressive	1.30e0	2.13e0	2.02e-1	1.04e1				
NeuralNetwork_100samples_layers_10_20_5	**GD-WeightDecay**	9.46e-2	3.04e-3	8.67e-2	9.85e-2				
	GD	1.28e-1	3.28e-3	1.19e-1	1.33e-1				
	Adam-Robust	6.03e-2	5.21e-3	4.99e-2	6.90e-2				
	Adam-AMSGrad	4.96e-2	5.12e-3	3.99e-2	5.89e-2				
	Adam	4.60e-2	4.49e-3	3.82e-2	5.37e-2				
	L-BFGS-MoreThuente	5.96e-2	4.36e-3	5.34e-2	7.10e-2				
	L-BFGS-Conservative	4.85e-2	9.73e-3	3.81e-2	7.99e-2				
	L-BFGS-Limited	5.79e-2	2.39e-2	3.92e-2	1.29e-1				
	L-BFGS-Aggressive	5.55e-2	4.41e-3	4.81e-2	6.45e-2				
	QQN-StrongWolfe	4.29e-2	6.97e-3	3.79e-2	6.26e-2				
	L-BFGS	1.83e-1	2.57e-1	3.89e-2	9.47e-1				
	QQN-GoldenSection	3.85e-2	1.08e-3	3.78e-2	4.14e-2				
	QQN-CubicQuadraticInterpolation	3.80e-2	1.13e-4	3.77e-2	3.82e-2				
	Adam-WeightDecay	3.82e-2	1.71e-5	3.81e-2	3.82e-2				
	GD-Nesterov	1.18e-1	5.89e-2	3.95e-2	1.72e-1				
	QQN-Bisection-1	3.87e-2	2.08e-3	3.78e-2	4.73e-2				
	QQN-Bisection-2	3.81e-2	1.11e-4	3.78e-2	3.83e-2				
	Adam-Fast	4.46e-2	7.66e-3	3.70e-2	6.58e-2				
	GD-Momentum	1.63e-1	2.75e-2	4.45e-2	1.78e-1				
	Trust Region-Conservative	1.48e-1	5.01e-3	1.28e-1	1.53e-1				
	GD-AdaptiveMomentum	1.74e-1	5.66e-3	1.66e-1	1.86e-1				
	Trust Region-Adaptive	1.94e-1	5.68e-2	1.56e-1	3.30e-1				
	Trust Region-Precise	1.60e-1	3.72e-3	1.52e-1	1.66e-1				
	Trust Region-Aggressive	7.84e-1	1.55e-1	3.46e-1	1.04e0				
	Trust Region-Standard	2.36e-1	2.65e-2	2.04e-1	3.07e-1				
SVM_100samples_5features_C1	**Adam-AMSGrad**	6.43e-1	1.44e-5	6.43e-1	6.43e-1				

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Table 1 – continued from previous page

Problem	Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)	
	Adam	6.43e-1	5.18e-7	6.43e-1	6.43e-1	1			
	Adam-Robust	6.43e-1	1.65e-4	6.43e-1	6.44e-1	1			
	Adam-WeightDecay	6.43e-1	1.36e-6	6.43e-1	6.43e-1	6			
	GD	6.43e-1	1.32e-6	6.43e-1	6.43e-1	2			
	L-BFGS-Limited	6.43e-1	1.94e-5	6.43e-1	6.43e-1	4			
	GD-WeightDecay	6.43e-1	2.96e-6	6.43e-1	6.43e-1				
	QQN-GoldenSection	6.43e-1	1.87e-5	6.43e-1	6.43e-1	2			
	L-BFGS-Conservative	6.43e-1	1.59e-5	6.43e-1	6.43e-1	1			
	QQN-Bisection-1	6.43e-1	1.39e-5	6.43e-1	6.43e-1				
	Trust Region-Conservative	2.82e0	1.25e0	6.45e-1	3.96e0	1			
	QQN-Bisection-2	6.43e-1	1.80e-5	6.43e-1	6.43e-1				
	QQN-CubicQuadraticInterpolation	6.43e-1	7.64e-7	6.43e-1	6.43e-1				
	QQN-StrongWolfe	6.43e-1	1.43e-5	6.43e-1	6.43e-1				
	GD-Nesterov	6.64e-1	5.99e-3	6.50e-1	6.76e-1				
	GD-Momentum	6.73e-1	9.01e-3	6.53e-1	6.91e-1				
	L-BFGS-MoreThuente	6.43e-1	1.35e-5	6.43e-1	6.43e-1				
	L-BFGS	6.43e-1	1.38e-12	6.43e-1	6.43e-1				
	Adam-Fast	6.84e-1	2.44e-2	6.44e-1	7.29e-1				
	L-BFGS-Aggressive	6.43e-1	1.41e-10	6.43e-1	6.43e-1				
	Trust Region-Precise	9.38e-1	2.76e-1	6.73e-1	1.58e0				
	GD-AdaptiveMomentum	7.53e-1	2.76e-2	7.12e-1	8.06e-1				
	Trust Region-Adaptive	4.68e0	6.93e0	7.07e-1	3.43e1				
	Trust Region-Aggressive	1.00e3	4.36e3	6.57e-1	2.00e4				
	Trust Region-Standard	3.47e2	9.80e2	7.26e-1	3.28e3				
SVM_200samples_10features_C1	**Adam-AMSGrad**	6.86e-1	1.05e-5	6.86e-1	6.86e-1	1			
	Adam	6.86e-1	9.76e-6	6.86e-1	6.86e-1	1			
	QQN-Bisection-1	6.86e-1	5.90e-6	6.86e-1	6.86e-1	1			
	QQN-StrongWolfe	6.86e-1	3.82e-6	6.86e-1	6.86e-1	1			
	QQN-Bisection-2	6.86e-1	1.16e-5	6.86e-1	6.86e-1	9			
	GD	6.86e-1	1.43e-6	6.86e-1	6.86e-1	4			
	Adam-WeightDecay	6.86e-1	7.69e-6	6.86e-1	6.86e-1	6			
	Adam-Robust	6.86e-1	1.01e-5	6.86e-1	6.86e-1	5			
	L-BFGS-MoreThuente	5.16e3	2.25e4	6.86e-1	1.03e5	5			
	QQN-GoldenSection	6.86e-1	6.68e-6	6.86e-1	6.86e-1	9			
	L-BFGS-Conservative	6.86e-1	5.85e-6	6.86e-1	6.86e-1	6			
	L-BFGS-Limited	6.86e-1	1.04e-4	6.86e-1	6.87e-1	7			
	QQN-CubicQuadraticInterpolation	6.86e-1	5.68e-6	6.86e-1	6.86e-1	2			
	GD-WeightDecay	6.86e-1	6.77e-7	6.86e-1	6.86e-1	1			
	L-BFGS	7.68e-1	3.55e-1	6.86e-1	2.32e0	3			
	Trust Region-Conservative	2.49e0	1.56e0	6.88e-1	4.05e0	1			
	L-BFGS-Aggressive	6.86e-1	6.90e-6	6.86e-1	6.86e-1	1			
	Adam-Fast	7.22e-1	2.34e-2	6.87e-1	7.51e-1				
	GD-Momentum	7.08e-1	5.01e-3	6.99e-1	7.17e-1				
	GD-Nesterov	7.03e-1	4.03e-3	6.94e-1	7.12e-1				
	Trust Region-Precise	9.09e-1	1.95e-1	7.00e-1	1.21e0				
	GD-AdaptiveMomentum	7.83e-1	1.76e-2	7.62e-1	8.35e-1				
	Trust Region-Adaptive	6.77e0	1.17e1	6.97e-1	3.46e1				
	Trust Region-Standard	8.76e-1	1.40e-1	6.90e-1	1.09e0				
	Trust Region-Aggressive	1.84e0	4.05e-1	7.56e-1	2.23e0				