

Table 1: Performance Results for Trigonometric_2D Problem

Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
L-BFGS-MoreThuente	4.44e-7	3.28e-7	1.25e-8	9.94e-7	85.4	100.0	0.002
QQN-CubicQuadraticInterpolation	3.11e-7	3.76e-7	6.47e-10	9.84e-7	95.8	100.0	0.003
QQN-StrongWolfe	4.90e-7	2.12e-7	2.93e-9	9.96e-7	107.8	100.0	0.004
L-BFGS-Conservative	5.22e-7	2.95e-7	3.92e-8	9.76e-7	129.4	100.0	0.003
QQN-Bisection-2	2.06e-7	2.73e-7	7.96e-10	8.24e-7	207.1	100.0	0.005
QQN-Bisection-1	2.08e-7	2.21e-7	1.49e-9	7.99e-7	220.8	100.0	0.005
GD	9.80e-7	1.07e-8	9.61e-7	9.99e-7	361.1	100.0	0.010
Adam	9.77e-7	1.59e-8	9.40e-7	9.98e-7	1269.5	100.0	0.026
QQN-GoldenSection	1.28e-3	5.56e-3	6.12e-10	2.55e-2	462.6	95.0	0.008
L-BFGS	4.06e-3	1.77e-2	8.58e-10	8.12e-2	93.3	90.0	0.002
L-BFGS-Limited	7.02e-6	2.23e-5	2.15e-8	1.00e-4	433.9	90.0	0.008
GD-WeightDecay	2.11e-4	6.48e-4	8.75e-7	2.81e-3	102.4	85.0	0.003
Adam-AMSGrad	1.08e-6	3.54e-7	9.47e-7	2.57e-6	1241.2	85.0	0.028
L-BFGS-Aggressive	3.62e-4	1.35e-3	7.20e-8	6.20e-3	843.0	80.0	0.009
Adam-WeightDecay	1.76e-5	4.01e-5	3.77e-7	1.63e-4	362.9	75.0	0.008
Adam-Fast	6.08e-3	1.20e-2	1.89e-8	5.66e-2	47.6	5.0	0.001
Adam-Robust	3.10e-3	1.20e-2	5.08e-7	5.56e-2	442.4	5.0	0.010
GD-AdaptiveMomentum	7.65e-3	4.04e-3	5.90e-5	1.24e-2	23.2	0.0	0.001
GD-Momentum	3.43e-2	2.95e-2	2.30e-4	8.79e-2	22.1	0.0	0.001
GD-Nesterov	2.31e-2	2.66e-2	5.79e-4	7.14e-2	24.2	0.0	0.001
Trust Region-Conservative	8.94e-3	1.37e-2	1.87e-3	4.88e-2	43.2	0.0	0.000
Trust Region-Adaptive	8.77e0	2.18e1	1.18e-2	8.47e1	12.8	0.0	0.000
Trust Region-Precise	1.11e-1	2.96e-1	1.34e-2	1.39e0	16.8	0.0	0.000
Trust Region-Aggressive	2.50e1	1.94e1	3.36e-2	5.71e1	18.3	0.0	0.000
Trust Region-Standard	1.22e1	2.59e1	2.19e-1	9.57e1	13.5	0.0	0.000