

Table 1: Performance Results for PenaltyI\_2D\_alpha1e6 Problem

Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
<b>QQN-Bisection-1</b>	1.12e0	8.85e-7	1.12e0	1.13e0	1032.0	0.0	0.033
QQN-GoldenSection	1.13e0	1.00e-4	1.12e0	1.13e0	2567.9	0.0	0.048
QQN-CubicQuadraticInterpolation	1.12e0	2.16e-16	1.12e0	1.12e0	38.0	0.0	0.001
QQN-StrongWolfe	1.14e0	1.65e-2	1.12e0	1.19e0	3162.1	0.0	0.083
L-BFGS-Conservative	1.13e0	2.13e-2	1.12e0	1.22e0	1183.8	0.0	0.015
L-BFGS-Limited	1.18e0	5.23e-2	1.13e0	1.31e0	4341.4	0.0	0.029
Adam-Robust	2.11e0	2.17e0	1.13e0	1.02e1	107.1	0.0	0.002
Adam	1.17e0	1.42e-1	1.13e0	1.79e0	625.9	0.0	0.012
Adam-AMSGrad	1.16e0	5.02e-2	1.13e0	1.35e0	647.9	0.0	0.015
Adam-WeightDecay	1.59e0	9.85e-1	1.14e0	4.57e0	226.2	0.0	0.005
GD-AdaptiveMomentum	7.74e2	1.18e3	1.15e0	3.84e3	17.6	0.0	0.001
QQN-Bisection-2	2.42e0	1.73e0	1.17e0	6.97e0	299.3	0.0	0.007
L-BFGS-Aggressive	4.69e4	1.12e5	1.17e0	3.51e5	2664.3	0.0	0.049
L-BFGS-MoreThuente	4.78e0	2.66e0	1.18e0	8.48e0	2878.8	0.0	0.042
Adam-Fast	1.01e2	2.80e2	1.26e0	1.09e3	22.0	0.0	0.000
GD-Momentum	6.67e1	2.53e2	1.26e0	1.16e3	13.0	0.0	0.000
GD	1.37e1	3.13e1	1.28e0	1.22e2	14.9	0.0	0.000
GD-WeightDecay	5.08e0	1.33e1	1.34e0	6.31e1	13.2	0.0	0.000
GD-Nesterov	1.46e2	3.37e2	1.38e0	1.23e3	13.9	0.0	0.000
L-BFGS	7.22e4	1.26e5	1.52e0	3.42e5	109.5	0.0	0.002
Trust Region-Conservative	1.39e5	8.98e4	8.35e3	4.03e5	3002.0	0.0	0.019
Trust Region-Aggressive	1.39e5	7.17e4	1.23e4	2.70e5	3002.0	0.0	0.019
Trust Region-Adaptive	1.32e5	8.14e4	1.57e4	3.15e5	3002.0	0.0	0.019
Trust Region-Precise	1.67e5	7.86e4	2.57e4	2.92e5	3002.0	0.0	0.018
Trust Region-Standard	1.43e5	8.01e4	3.60e4	3.21e5	3002.0	0.0	0.019