

Table 1: Performance Results for PenaltyI\2Dn\_alpha1e6Problem

Optimizer	Mean Final Value	Std Dev	Best Value	Worst Value	Mean Func Evals	Success Rate (%)	Mean Time (s)
QQN-GoldenSection	1.13	$2.31 \times 10^{-4}$	1.12	1.13	887.7	0.0	0.015
QQN-Bisection-1	1.13	$8.27 \times 10^{-4}$	1.12	1.13	446.4	0.0	0.013
L-BFGS-Conservative	1.13	$7.98 \times 10^{-3}$	1.12	1.15	566.1	0.0	0.007
QQN-Backtracking	1.68	$6.37 \times 10^{-1}$	1.12	2.90	743.0	0.0	0.019
QQN-StrongWolfe	1.85	1.25	1.14	5.89	648.7	0.0	0.017
QQN-CubicQuadraticInterpolation	1.95	1.27	1.13	7.20	391.8	0.0	0.015
QQN-Bisection-2	3.13	2.61	1.15	9.91	314.2	0.0	0.007
Adam-WeightDecay	3.16	4.45	1.14	$1.62 \times 10^1$	222.6	0.0	0.005
GD-WeightDecay	$1.10 \times 10^1$	$4.00 \times 10^1$	1.35	$1.86 \times 10^2$	13.0	0.0	0.000
GD	$1.86 \times 10^1$	$3.83 \times 10^1$	1.24	$1.47 \times 10^2$	14.4	0.0	0.000
GD-Momentum	$5.39 \times 10^1$	$1.27 \times 10^2$	1.51	$4.49 \times 10^2$	13.2	0.0	0.000
Adam-Fast	$1.39 \times 10^2$	$5.56 \times 10^2$	1.56	$3.27 \times 10^3$	22.6	0.0	0.000
GD-Nesterov	$2.30 \times 10^2$	$5.44 \times 10^2$	1.26	$2.00 \times 10^3$	13.6	0.0	0.000
Adam	$7.23 \times 10^3$	$1.43 \times 10^4$	1.13	$5.83 \times 10^4$	436.4	0.0	0.009
Adam-AMSGrad	$8.71 \times 10^3$	$1.21 \times 10^4$	1.13	$3.79 \times 10^4$	438.1	0.0	0.010
L-BFGS-Aggressive	$1.45 \times 10^4$	$6.32 \times 10^4$	1.20	$3.03 \times 10^5$	636.2	0.0	0.010
QQN-MoreThuente	$2.89 \times 10^4$	$1.34 \times 10^4$	$4.65 \times 10^3$	$5.86 \times 10^4$	487.0	0.0	0.011
L-BFGS	$6.95 \times 10^4$	$1.17 \times 10^5$	2.68	$2.94 \times 10^5$	107.0	0.0	0.001
Trust Region-Adaptive	$1.47 \times 10^5$	$8.72 \times 10^4$	$3.73 \times 10^4$	$3.35 \times 10^5$	602.0	0.0	0.004
Trust Region-Conservative	$1.48 \times 10^5$	$7.43 \times 10^4$	$1.63 \times 10^4$	$2.83 \times 10^5$	602.0	0.0	0.004
Trust Region-Standard	$1.76 \times 10^5$	$1.10 \times 10^5$	$2.62 \times 10^4$	$3.49 \times 10^5$	602.0	0.0	0.004