

Table 1: Performance Results for PenaltyI\5Dn\_alpha1e6Problem

| Optimizer                       | Mean Final Value   | Std Dev               | Best Value         | Worst Value        | Mean Func Evals | Success Rate (%) | Mean Time (s) |
|---------------------------------|--------------------|-----------------------|--------------------|--------------------|-----------------|------------------|---------------|
| QQN-GoldenSection               | 2.81               | $7.42 \times 10^{-4}$ | 2.81               | 2.82               | 910.8           | 0.0              | 0.016         |
| QQN-Bisection-1                 | 2.82               | $2.25 \times 10^{-3}$ | 2.81               | 2.82               | 445.1           | 0.0              | 0.014         |
| L-BFGS-Conservative             | 2.86               | $3.91 \times 10^{-2}$ | 2.81               | 2.95               | 748.9           | 0.0              | 0.008         |
| QQN-StrongWolfe                 | 8.87               | 5.56                  | 3.21               | $2.48 \times 10^1$ | 604.6           | 0.0              | 0.016         |
| QQN-Backtracking                | 9.91               | 5.81                  | 3.47               | $2.65 \times 10^1$ | 724.1           | 0.0              | 0.021         |
| Adam-WeightDecay                | 9.94               | 8.63                  | 2.85               | $3.42 \times 10^1$ | 263.9           | 0.0              | 0.006         |
| QQN-Bisection-2                 | $1.13 \times 10^1$ | 4.68                  | 5.79               | $1.89 \times 10^1$ | 371.8           | 0.0              | 0.009         |
| QQN-CubicQuadraticInterpolation | $1.62 \times 10^1$ | $1.34 \times 10^1$    | 3.16               | $5.97 \times 10^1$ | 394.1           | 0.0              | 0.015         |
| GD-WeightDecay                  | $4.19 \times 10^1$ | $9.75 \times 10^1$    | 3.57               | $3.94 \times 10^2$ | 14.7            | 0.0              | 0.000         |
| GD-Momentum                     | $8.60 \times 10^1$ | $1.74 \times 10^2$    | 3.70               | $7.37 \times 10^2$ | 14.5            | 0.0              | 0.000         |
| GD                              | $1.01 \times 10^2$ | $1.65 \times 10^2$    | 3.00               | $6.32 \times 10^2$ | 16.1            | 0.0              | 0.000         |
| GD-Nesterov                     | $1.26 \times 10^2$ | $2.80 \times 10^2$    | 3.49               | $1.02 \times 10^3$ | 13.6            | 0.0              | 0.000         |
| Adam-Fast                       | $9.73 \times 10^2$ | $1.39 \times 10^3$    | 4.01               | $6.27 \times 10^3$ | 24.4            | 0.0              | 0.000         |
| Adam-AMSGrad                    | $2.85 \times 10^4$ | $2.46 \times 10^4$    | 2.82               | $7.56 \times 10^4$ | 502.0           | 0.0              | 0.012         |
| Adam                            | $3.48 \times 10^4$ | $2.25 \times 10^4$    | $2.38 \times 10^3$ | $7.47 \times 10^4$ | 502.0           | 0.0              | 0.010         |
| QQN-MoreThuente                 | $5.16 \times 10^4$ | $1.62 \times 10^4$    | $1.90 \times 10^4$ | $7.64 \times 10^4$ | 487.0           | 0.0              | 0.011         |
| L-BFGS                          | $7.19 \times 10^4$ | $1.02 \times 10^5$    | 7.42               | $4.44 \times 10^5$ | 95.6            | 0.0              | 0.001         |
| L-BFGS-Aggressive               | $1.97 \times 10^5$ | $2.38 \times 10^5$    | 3.82               | $6.56 \times 10^5$ | 423.6           | 0.0              | 0.005         |
| Trust Region-Standard           | $3.18 \times 10^5$ | $9.88 \times 10^4$    | $1.58 \times 10^5$ | $4.75 \times 10^5$ | 602.0           | 0.0              | 0.004         |
| Trust Region-Conservative       | $4.01 \times 10^5$ | $1.09 \times 10^5$    | $1.14 \times 10^5$ | $5.61 \times 10^5$ | 602.0           | 0.0              | 0.004         |
| Trust Region-Adaptive           | $4.01 \times 10^5$ | $1.37 \times 10^5$    | $1.37 \times 10^5$ | $6.54 \times 10^5$ | 602.0           | 0.0              | 0.004         |