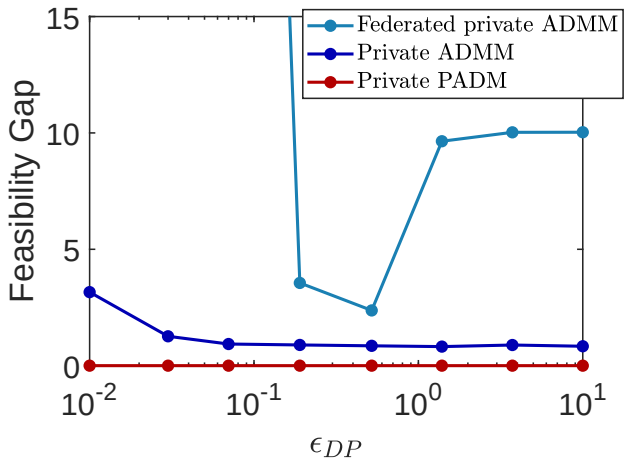

Figure 1: Feasibility gaps of federated private ADMM [Cyffer et al. 2023], private ADMM [Chan et al. 2024] and private PADM (ours) at 500-th iteration under eight privacy budgets ϵ_{DP}.

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ϵ_{DP}	0.01	0.03	0.07	0.19	0.52	1.39	3.73	10
Federated private ADMM	9030.94	1154.55	84.23	3.55	2.37	9.64	10.03	10.03
Private ADMM	3.16	1.26	0.93	0.89	0.85	0.82	0.89	0.83
Private PADM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 2: Optimality gaps of PADM-$\mathcal{L}_\lambda$ and PADM-$\mathcal{N}_\sigma$ at 1000-th iteration under eight privacy budgets ϵ_{DP}.

ϵ_{DP}	0.01	0.03	0.07	0.19	0.52	1.39	3.73	10
PADM-$\mathcal{L}_\lambda$	105.0202	35.0743	2.4273	0.3246	0.0682	0.0287	0.0227	0.0220
PADM-$\mathcal{N}_\sigma$	1.3808	0.1470	0.0417	0.0245	0.0220	0.0221	0.0214	0.0227

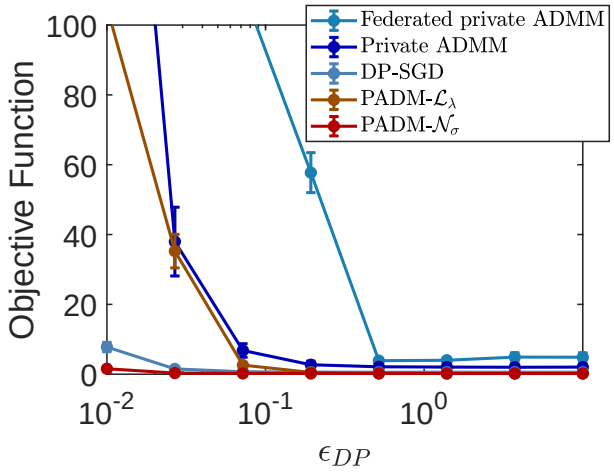

Figure 2: Final objective function values (mean $\pm$ STD) of federated private ADMM [Cyffer et al. 2023], private ADMM [Chan et al. 2024], DP-SGD [Feldman et al. 2018], PADM-$\mathcal{L}_\lambda$ (ours), and PADM-$\mathcal{N}_\sigma$ (ours).

Table 3: Final objective function values (mean $\pm$ STD) of federated private ADMM [Cyffer et al. 2023], private ADMM [Chan et al. 2024], DP-SGD [Feldman et al. 2018], PADM-$\mathcal{L}_\lambda$ (ours), and PADM-$\mathcal{N}_\sigma$ (ours).

ϵ_{DP}	0.01	0.03	0.07	0.19	0.52	1.39	3.73	10
Federated Private ADMM	27785.87 ± 5126.50	617.35 ± 109.51	110.23 ± 9.86	57.74 ± 5.72	3.87 ± 0.51	3.99 ± 0.66	4.89 ± 1.25	4.87 ± 1.27
Private ADMM	253.29 ± 58.27	37.99 ± 9.85	6.80 ± 1.94	2.70 ± 1.02	2.12 ± 0.76	2.04 ± 0.87	1.99 ± 0.81	2.03 ± 0.70
DP-SGD	7.78 ± 1.34	1.51 ± 0.22	0.70 ± 0.07	0.58 ± 0.04	0.56 ± 0.02	0.57 ± 0.02	0.56 ± 0.02	0.56 ± 0.02
PADM-$\mathcal{L}_\lambda$	105.20 ± 4.39	35.25 ± 4.81	2.61 ± 0.45	$\mathbf{0.50 \pm 0.06}$	$\mathbf{0.25 \pm 0.01}$	$\mathbf{0.21 \pm 0.005}$	$\mathbf{0.20 \pm 0.004}$	$\mathbf{0.20 \pm 0.004}$
PADM-$\mathcal{N}_\sigma$	$\mathbf{1.56 \pm 0.32}$	$\mathbf{0.33 \pm 0.03}$	$\mathbf{0.22 \pm 0.007}$	$\mathbf{0.20 \pm 0.004}$	$\mathbf{0.20 \pm 0.004}$	$\mathbf{0.20 \pm 0.004}$	$\mathbf{0.20 \pm 0.004}$	$\mathbf{0.20 \pm 0.004}$