

A useful Latex template

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Abstract

We study an interesting problem in statistics and machine learning.

1 Main results

We define two linear maps $\mathcal{D}, \mathcal{F} : \mathbb{R}^{d \times d} \rightarrow \mathbb{R}^{d \times d}$, such that for any $\mathbf{A} = (A_{ij}) \in \mathbb{R}^{d \times d}$, we have $[\mathcal{D}(\mathbf{A})]_{ij} := A_{ij} \mathbf{1}_{\{i=j\}}$ and $\mathcal{F}(\mathbf{A}) := \mathbf{A} - \mathcal{D}(\mathbf{A})$. In other words, $\mathcal{D}(\mathbf{A})$ and $\mathcal{F}(\mathbf{A})$ correspond to the diagonal and off-diagonal parts of \mathbf{A} respectively. We write $X \perp\!\!\!\perp Y$ if X and Y are independent.

Proof. Define an event

$$\mathcal{A} := \{\|\widetilde{\mathbf{W}} - p^{-2} \mathbf{1}_d \mathbf{1}_d^\top\|_\infty \leq p^{-2}\}. \quad (1)$$

For $j, k \in [d]$, write $\widehat{P}_{jk} := n^{-1} \sum_{i=1}^n \omega_{ij} \omega_{ik}$. Then by a union bound and Bernstein's inequality, we have

$$\mathbb{P}(\mathcal{A}^c) \leq \sum_{j,k \in [d]} \mathbb{P}(\widehat{P}_{jk} < p^2/2) \leq d^2 e^{-3np^2/32}.$$

Note that on \mathcal{A} , we have $\|\widetilde{\mathbf{W}}\|_\infty \leq 2p^{-2}$. The desired bounds then follow respectively from the following inequalities: $\|\widetilde{\mathbf{W}}\|_{\text{op}} \leq d\|\widetilde{\mathbf{W}}\|_\infty$, $\|\widetilde{\mathbf{W}}\|_{1 \rightarrow 1} = \|\widetilde{\mathbf{W}}\|_{\infty \rightarrow \infty} \leq d\|\widetilde{\mathbf{W}}\|_\infty$, $\|\widetilde{\mathbf{W}}\|_1 \leq d^2\|\widetilde{\mathbf{W}}\|_\infty$, $\|\widetilde{\mathbf{W}}\|_F \leq d\|\widetilde{\mathbf{W}}\|_\infty$ and $\|\widetilde{\mathbf{W}}\|_{2 \rightarrow \infty} \leq d^{1/2}\|\widetilde{\mathbf{W}}\|_\infty$. \square

2 Numerical study

The simulation shows significant advantage of Method A over Method B.

Let's make a plot here. Figure 1 compares clipped and original figures.



Figure 1: Bamboos: Should we clip them or not?

Next let's see how we should create tables.

Methods	RSS	$\ \hat{\Theta} - \Theta^*\ _F$	$\ \sin \Theta(\hat{\Theta}, \Theta^*)\ _F$
IHT	1.008	0.018	8e-16
Nuclear	1.006	0.033	1e-14

Table 1: $n = 2000, r = 1, d = 10, k = 1, s = 2, \rho = 0$

Table 1 is a good-looking table. Finally let's cite some papers. [Oliveira \(2016\)](#) may be too hard for undergrads. [Rigollet and Hütter \(2017\)](#) is a nice tutorial on high-dimensional statistics. Pay attention to the format of the cite key, with which I hope you can stick.

References

- OLIVEIRA, R. I. (2016). The lower tail of random quadratic forms with applications to ordinary least squares. *Probability Theory and Related Fields* 1–20.
- RIGOLLET, P. and HÜTTER, J.-C. (2017). High-dimensional statistics. Tech. rep., Massachusetts Institute of Technology.