THE UNIVERSITY OF CHICAGO | THE COMMITTEE ON COMPUTATIONAL AND APPLIED MATHEMATICS

COLLOQUIUM

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Convex relaxation approaches for high-dimensional optimal transport

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Jones 303, 5747 S. Ellis Ave. Chicago, IL 60637

ABSTRACT

Optimal transport (OT) is a powerful tool in mathematics and data science but faces severe computational and statistical challenges in high dimensions. We propose convex relaxation approaches based on marginal and cluster moment relaxations that exploit locality and correlative sparsity in the distributions. These methods approximate high-dimensional couplings using low-order marginals and sparse moment statistics, yielding semidefinite programs that provide lower bounds on the OT cost with greatly reduced complexity. For Gaussian distributions with sparse correlations, we prove reductions in both computational and sample complexity, and experiments show the approach also works well for non-Gaussian cases. In addition, we demonstrate how to extract transport maps from our relaxations, offering a simpler and interpretable alternative to neural networks in generative modeling. Our results suggest that convex relaxations can provide a promising path for dimension reduction in high-dimensional OT.

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