Domain-Liftability of Relational Marginal Polytopes (Appendix)

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A A Lemma Used in Theorem 3

Lemma 1. *Given a set S of linear inequality constraints, there is an algorithm to find a minimal subset $S' \subseteq S$ such that S' specifies the same polytope as S, in polynomial time in the size of S.*

Proof. Without loss of generality, we assume that every constraint c_j in S is of the form $\sum_i a_{j,i} x_i \leq b_j$. We construct $|S|$ linear programs: The i-th linear program uses all constraints in S except c_j as the constraints, and its objective function is $\max \sum_i a_{j,i} x_i$. If the optimal solution of this linear program is strictly larger than b_j, then we add c_j into S'. It is not difficult to see that every constraint in S' cannot be implied by other constraints, or else that constraint cannot be added into S', so S' is minimal. Besides, we only have $|S|$ linear programs each of which can be solved in polynomial time (e.g., using some interior-point methods), hence the whole procedure is in polynomial time. □