The Interval Transportation Problem with a Cost Matrix Immune against the More-for-Less Paradox

Francesco Carrabs, Raffaele Cerulli, Ciriaco D'Ambrosio[1],
Federico Della Croce[2,3], Monica Gentili[1,4]

[1] Department of Mathematics, University of Salerno, Via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy
{fcarrabs, raffaele, cdambrosio, mgentili}@unisa.it

[2] Dipartimento di Ingegneria Gestionale e della Produzione, Politecnico di Torino, (TO), Italy
federico.dellacroce@polito.it

[3] CNR, IEIIT, Torino, (TO), Italy

[4] Industrial Engineering Department, University of Louisville, USA
monica.gentili@louisville.edu

Abstract

We study the transportation problem (TP) where supply and demand levels vary over given interval values, referred to as the Interval Transportation Problem (ITP). For each realization of the supplies and demands, within the given interval, the problem reduces to the classical TP, that is the problem of finding the minimum cost transportation plan such that the capacity at suppliers is not exceeded and the demand requirements are satisfied. Hence, ITP can be seen as a collection of classical transportation problems each associated with a specific realization of the supplies and demands. One important challenge in this context is to compute the range of values of the optimal cost, that is in determining the best and the worst values of the optimal cost of ITP among all the realizations of the uncertain parameters. Determining the best optimal value is an easy task, finding the worst optimal value is not and it is the focus of this research. We address this problem for a specific version of ITP, namely the Immune Interval Transportation Problem (IITP), obtained when the cost matrix is immune against the more-for-less paradox. We present some polyhedral properties related to the polyhedron of the realizations of the supply and demand associated with feasible TPs. We prove that the worst optimal value corresponds to the optimal cost of a transportation problem associated with a quasi-extreme realization of supplies and demands, that is a realization for which at most one, among all the supplies, might not be at either the extremes of its associated interval of values.

Keywords : *Transportation Problem, Interval RHS, More-for-Less Paradox.*