Multi-location Assortment Optimization

We first consider the single location constrained assortment optimization problem under the general mixed multinomial logit model. This problem is NP-hard and even moderately sized instances of this problem are challenging to solve directly using standard mixed-integer linear optimization formulations. For this model, we develop a novel conic quadratic mixed-integer formulation. This new formulation, together with valid inequalities exploiting the capacity constraints, enables us the solution of large instances using commercial optimization software.

We then consider the assortment optimization problem in an online setting where a retailer uses multiple distribution centers to fulfill customer orders. It is assumed that each distribution center is primarily responsible for a geographical region whose customers' choice is governed by a separate multinomial logit model. A distribution center can satisfy the demand from a region that it is not primarily responsible for, but this incurs an additional shipping cost for the retailer. The problem for the retailer is to determine which products to carry in each of its distribution centers and which products to offer for sale in each region so as to maximize its expected profit (revenue minus the shipping costs). We extended the conic quadratic mixed integer programming formulation in the first part to this multi-location problem. Numerical experiments show that our conic approach, combined with valid inequalities again over-performs the mixed integer linear programming formulation and enables us to solve large instances optimally. Finally, we study the effect of various factors such as no-purchase preference, capacity constraint and shipping cost on company's profitability and assortment selection.

We finally study the two-location assortment optimization problem where a retailer needs to simultaneously determine the assortment in a local depot where it provides faster service and the assortment in a distribution center where it provides regular service. Under a multinomial logit model, we provide initial results to efficiently determine the assortments based on product popularities and net revenues obtained through two fulfillment options.