Optimization Models for the Integration of Transit and Parking Policies

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Public transit systems are not only essential for urban mobility but also as a reliable system to address the current environmental and economic concerns. However, these systems are usually a source of financial problems worldwide scale, as their revenues are rarely enough to cover their expenses.

In this context, four strategic mixed integer non-linear optimization models were developed to integrate transit and parking systems by managing transit fares and parking fees so that local transportation authorities can simultaneously improve transit modal shares and decrease the operating deficits of public transit companies.

These models were applied to cities divided into zones, where trips can be made by car, bus, or not made at all if travel costs are considered too high by travelers. Logit models of the generalized costs are used to describe modal choice, considering transit fares and parking fees as decision variables. Based on the existence or not of competition among operators/companies, two different approaches were considered. On the one hand, three out of the four models assume a cooperative environment, dealing with different goals (maximizing the joint social benefits or minimizing the joint deficits) and traffic behavior assumptions (static or dynamics). On the other hand, a competitive environment was addressed with a two-stage optimization model aiming at finding the Nash equilibrium for each stage where the payoff is the net revenue achieved by each operator/company.

The integrated transit-parking planning models developed provide a better understanding of how pricing schemes affect the city mobility dynamics. They also provide insights into how an unlucrative transit system can become profitable by only managing transit fares and parking fees while ensuring reasonable levels of service. Furthermore, aspects such as congestion, parking capacity or transit system supply can also be positively affected by adjusting transit fares and parking fees.

Keywords: transit planning; parking planning; integrated transit-parking; optimization modeling.