Setting Inventory Levels in a Bike Sharing Network

Sharon Datner[1], Tal Raviv[*1], Michal Tzur[1], and Daniel Chemla[2,3]

[1]Department of Industrial Engineering, Tel Aviv University – Israel
[2]Université Paris Est – Université Paris Est (UPE) – France
[3]Universite Paris 13, Paris – université Paris 13 – France

Abstract

A major issue that Bike Sharing Systems operators must address is the non-homogeneous asymmetric demand processes. These demand processes create an inherent imbalance, thus leading to shortages either of bicycles when users are attempting to rent them or of vacant lockers when users are attempting to return them. The predominant approach taken by operators to cope with this difficulty is to reposition bicycles to rebalance the inventory levels at the different stations. Most repositioning studies assume that a target inventory level or range of inventory level is known for each station. In this paper, we focus on determining the correct target level for repositioning according to a well-defined objective. This is a challenging task because of the intricate nature of the user behaviour in the system. For example, if bicycles are not available at the desired origin of a user's journey, the user may either abandon the system, use other means of transportation, or look for available bicycles at a neighbouring station. If in another case, a locker is not available at a user's destination, then that user is obliged to find a station with available space to return the bicycle to the system. Thus, an empty/full station can create a spill over of demand to nearby stations. In addition, stations are related by origin-destination pairing. We take this effect into consideration when setting target inventory levels and develop a robust guided local search algorithm for that purpose. We show that neglecting the interactions among stations leads to inferior decision-making.

[*]Speaker