At the Chairs of **Logistics and Supply Chain Management** of TUM School of Management and **Operations Research** of TUM Mathematics we are looking for an interested and qualified student to conduct his/her

Master thesis

on the topic:

Extending Hotelling's Law and the Competitive Facility Location Problem to Rebalancing of Car Sharing Systems

In (free floating) one-way car-sharing, users can take any car in the operating area and return it at any other location. One of the main challenges is to distribute vehicles evenly across the operating area and to relocate them to meet the demand. In cities such as Munich, more than one competitor offers his service to users. We like to study the impact of a second competitor on the positioning of vehicles: Are vehicles positioned next to each other or in the largest possible distance? Hotelling's Law (Hotelling, 1929) states that two competitors will always meet at the middle of a line to improve their individual payoff. The Competitive Facility Location Problem (Gur et al., in press) extends these results to graphs. We like to extend Hotelling's law in the case where not only one good per customer, but multiple goods have to be distributed on a path or across a graph. Unlike the "regular" Hotelling's law or Facility Location Problem, resources are capacitated (a vehicle vanishes with the first customer). Secondly, customers only use cars up to a given distance. In particular we are interested in existing Nash equilibria and their impact on (social) welfare. Depending on the student's background/field of study and research interests we can offer different tasks. The specific tasks will be discussed with the student.

Selected research tasks:

- Literature Overview on Game Theory focusing on Hotelling's law and Voronoi Games
- Literature Overview on Car Sharing focusing on competition
- Model description
- Simulation of best response model on different topologies
- Study of Nash equilibria and social welfare on different topologies
- Algorithm to detect Nash equilibria

Requirements:

The thesis is for Master students of the study-program Mathematics or TUM-BWL (with a major in Supply Chain Management and strong background in mathematics). The ability to work independently as well as analytical skills are required. Knowledge of game theory and linear programming is mandatory. The thesis can be written in German or English.

Begin:	as soon as possible
Advisor:	Layla Martin and Marilena Leichter
Application:	Email with curriculum vitae and transcript of records to log.theses@tum.de (TUM-BWL) or master.or@tum.de (Mathematics)
Sources:	Hotelling, 1929; Gur (working paper), Bandyapadhyay, 2015