Large-Scale Allocation of Personalized Incentives

Definitions and Framework

**Personalized-Incentive Policy**
- **Topic:** Mode choice for the commute to work of many individuals
- Each mode of transportation is characterized by an individual value (or utility) and a level of CO2 emissions
- A regulator proposes incentives to induce individual to switch to another transportation mode
- **Goal of the regulator:** Minimize CO2 emissions, subject to the budget constraint
- **Assumptions:** Fixed congestion; independent CO2 emissions

**Solution under Perfect Information**

Multiple-Choice Knapsack Problem and Greedy Algorithm
- **Perfect information:** The regulator knows exactly the individual values for each mode of each commuter
- The regulator optimization problem reduces to a multiple-choice knapsack problem
- A near-optimal incentive allocation can be found in polynomial time, using a greedy algorithm from Kellerer et al. (2004)
- **Properties:** Anytime algorithm, diminishing returns on budget spent

**Solution under Imperfect Information**

Choice Probabilities and a Novel Algorithm
- **Imperfect information:** The regulator knows the distribution of the individual values
- A novel polynomial-time algorithm can be used to find a near-optimal incentive allocation
- The algorithm uses acceptance probabilities (probability that the individual accepts the incentive)

Large-Scale Application

**Mode Choice in Lyon Metropolitan Area**
- Over 200 thousands individuals and over 1 million alternatives
- 5 modes of transportation: car, public transit, walking, cycling and motorcycle
- **Four scenarios:**
  1. imperfect information with default unobserved,
  2. imperfect information with default observed,
  3. perfect information,
  4. proportional subsidy
- With a daily budget of 25k euros, CO2 emissions can be reduced by 25 tons (scenario 1), 50 tons (scenario 2), 67 tons (scenario 3) or 15 tons (scenario 4)
- The average incentive amount is 3.99 euros in scenario 1, 1.56 euros in scenario 2 and 1.92 euros in scenario 3
- The mode share of car decreases from 57.3 % to 57.1 % (scenario 1), 52.6 % (scenario 2) or 51.8 % (scenario 3)