Exercises for CIVIL-455 Transportation economics: Congestion Game

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May 6, 2025

Q1 Consider a four-link network as shown in Figure 1.
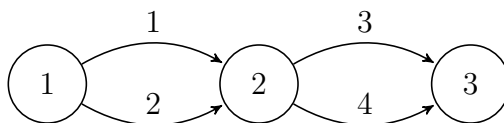

Figure 1: A four-link network

(a) Find the user equilibrium link flow and travel time for the network, where

$$t_1 = 2 + x_1^2$$
$$t_2 = 3 + x_2$$
$$t_3 = 1 + 2x_3^2$$
$$t_4 = 2 + 4x_4$$

The OD demand is 4 units of flow between nodes 1 and 3.

(b) Find the SO flow pattern for the network. Compare it to the UE flow pattern.

(c) Does the SO have a unique solution in terms of path flows? Explain your answer.

Q2 Recall the Cournot competition example with Uber and Lyft. Consider the following scenario: Uber decreases marginal cost by 33.3%

(a) Answer the following questions: What is the effect of the decrease in marginal cost of Uber on:

- Market share of both firms
- Equilibrium price

- Total supply

- Profit of either firm

(b) How would your answer change if competition is according to Bertrand?