CEE 598 Urban Transportation Model (UTM) Problem Set 5

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Problem 1

1. Is the transportation network viable? Explain why or why not.

   Yes, the network is viable because it is possible for us to lead total emissions to be less than 3. For example, the total emissions will be 2 if all traffic flow is on link a. Even though we distribute the traffic flow evenly on three links, the total emissions are 3.

2. Suppose that the environmental quality standard is now tightened to 1.5. Is the network viable in that case? Explain why or why not.

   No, even if we assign all traffic flow to the most sustainable link (link a), the total emissions are 2 which exceeds the standard.

Problem 2

Assume that the drivers when traversing a transportation network behave in a user-optimized way. Determine how you will construct a road between an origin-destination pair so that if the road is utilized, the user costs incurred in equilibrium cannot exceed those incurred for the origin-destination pair in equilibrium prior to the addition of the road in the transportation network.

The method to eliminate additional user costs after the construction of the new road is to avoid Brasses' paradox. Pas and Shari [1] shows that Brasses' paradox happens if only the total demand for travel lies within a certain range of values. That is, we should control the total demand for travel out of this range. However, there will be no flow on the additional link if the total demand exceeds the upper bound of the range [1], which leads the construction of the new link to be meaningless. Therefore, we should make the total demand for travel less than the lower bound of the range. One of the most common methods is charging from the driver. Charging users the marginal cost of travel can guarantee that the addition of a new link to an existing system won't increase the total travel time [1]. Another effective way is to only allow some of the vehicle drivers can get into the congested areas. For example, Singapore and Korea enforced this method by recognizing drivers' vehicle plates. Only those with qualified plates can be permitted to enter the congested zone. This is another common way to decrease the demand for travel. However, the shortcoming of this policy is the violation of human rights.

Reference

[1] Pas, Eric I., and Shari L. Principio. "Braess' paradox: Some new insights." *Transportation Research Part B: Methodological* 31.3 (1997): 265-276.