Economics of Information Networks
Homework 6
Due November 22, 2018 at 11:00am
Requirements

Submit your homework *by email to*

`"Economics of Information Networks" <turnbull@sk.tsukuba.ac.jp>`

The `Subject:` should be `01CN901 Homework #6` (in hankaku romaji). Use this class number, even if you are registered according to a different code. Your email must contain your *name* and *student ID number*.

Problems

Consider the following variants on the Braess model.

1. Consider the original network flow problem (without the new bridge), but with asymmetric capacities for the bridges: the time to cross $C \to B$ is longer: $y/80$. Is there an equilibrium? If so, what is it? If not, why not?

2. Generalize the formula for equilibrium in part 1 to the case where the time to cross $A \to D$ is αx and to cross $C \to B$ is βy. Ignore boundary conditions (*alpha* and *beta* are "too different" for the formula to work).

3. Discuss the boundary conditions for the formula in part 2.

4. In the three-bridge network, formulate the relevant equations when, instead of labelling paths with traffic levels, we label links with traffic levels:
   $A \to D$: x
   $C \to B$: y
   $D \to C$: z
   $A \to C$: u
   $D \to B$: v
   Compare this notation with the notation used in class. Which is easier to solve? Which provides more information, or are they the same?

   You can save yourself a lot of annoyance by choosing appropriate notation! You're also likely to make your readers (including advisors and examiners!) happier.

5. Realistically, bridges take time to cross. Suppose in the three-bridge problem it takes one minute to cross the bridge $D \to C$. How does the equilibrium change?

6. Is there a cost (in minutes) to crossing $D \to C$ large enough so that no driver will use that bridge in equilibrium? If so, what is the smallest such time? What are the equilibria for slightly smaller times?