SAND - Network Design

Objective:

This assignment aims to enhance the understanding of transportation planning and network design using the online java applet Simulator and Analyst of Network Design (SAND). SAND integrates computer visualization and Stochastic User Equilibrium (SUE) travel demand forecasting in a simulation environment such that users can make immediate changes to a given network and evaluate the effects of making these changes in terms of the resultant traffic pattern and the effectiveness of travel. Using SAND as a tool, students will play the role of transportation planners and decide how to spend resources on a congested road network to mitigate congestion under alternative goals.

Instructions:

SAND can be accessed online at http://street.umn.edu/SAND_appl.html. Click *Start SAND* to display the interface. Read the help file and follow the user instructions to get familiar with this tool.

We use the "river network" in SAND as the background. Use "Downtown" land use distribution and the default values for the global variables. Imagine that one bridge across the river is shut down. The crippled network is represented by "river network with a closed bridge" in the applet. It is assumed that travelers respond to bridge closure by changing their destinations and route choices but not travel frequencies. To simplify, it is assumed that constructing one additional lane-kilometer costs $1M.

Tasks:

As a transportation planner, you are asked to perform the following tasks:

First, evaluate the traffic conditions on the network with the bridge shut down and estimate the daily economic loss due to the increased travel delay after the bridge is closed.

Second, accommodate the congestion caused by bridge closure with different plans for an alternative set of goals. The goals are described as follows:

a. With the bridge permanently closed, you are asked to mitigate the congestion only by adding new lanes to remaining links such that the volume-capacity ratio on each link (roughly indicating level of service) is below 1.0. You need to achieve this goal while keeping your construction cost at the minimal. Considering the simulator displays the traffic pattern in the morning peak, number of lanes in each direction of a link is required to be equal so that the evening traffic can be accommodated as well.

b. With the bridge permanently closed, you are asked to mitigate the congestion only by adding new lanes to remaining links with a construction budget of $15M such that the user travel time is minimized.

c. Suppose the bridge is closed and will be reopened soon, you are asked to mitigate the congestion in the morning such that the level of service of each link in the network is below 1.0. You can both add new lanes within a budget of $10M and use temporary management measures such as shutting down some lanes on links, tolling congested links, etc. These management measures, to simplify, incur no cost. You need to achieve the goal while keeping total user travel time as low as you could.
d. Suppose the bridge needs to be re-constructed with at least two lanes in each direction (in this case, you need to work on the "river network" instead). In addition, you can also add lanes to other links with a total budget of $50M (including bridge re-construction). Your goal is to increase the level of accessibility from workers to jobs in the resultant network as much as you could.

Hints:

- This assignment is not asking for the optimal solution, but try to make your plan strategically;
- Adding new capacity to a link may induce demand on this link;
- The traffic level on a route could be reduced by improving a parallel route;

Third, you are asked to submit a formal proposal of 3-5 pages to the funding agency. In the report you need to 1) describe the background of this project 2) evaluate the present traffic conditions with the bridge closed and estimate the economic loss due to travel delay 3) present a set of alternative plans for the above described goals and illustrate their respective impacts in terms of the resultant traffic conditions and measures of effectiveness, and 4) propose one plan to the funding agency and explain why it should be funded.