SONG - Homework #1

Transportation Network Development System Analysis

The main objectives of this assignment are to help student

- learn to draw implications of alternative policies on transportation network
- understand transportation network development process, the influencing factors and players
- learn transportation planning model (modeling process)
- understand current transportation infrastructure investment decision making process
- learn and practice the method of system analysis

Statewide transportation plan is one of the major products generated out of the *federally-mandated transportation planning process*. The transportation plan is a long range (at least 20 years), multi-model future vision for the mobility of goods and people. The plan considers factors that may affect or be affected by local and regional transportation investments. Minnesota Department of Transportation (MnDOT) is the agency holding responsibility for administrating the state transportation budget. Currently, MnDOT is drafting the 2004 to 2024 Minnesota Statewide Transportation Plan. In preparation for the statewide transportation plan, MnDOT is developing a 20-year transportation investment and financing strategy for the development of transportation system.

You are a transportation planner/engineer working for a local transportation consulting firm, which newly won a contract with MnDOT to perform a pilot study to test *in concept* the effects of possible policy initiatives or alternative decision-making assumptions in transportation investment and financing. In particular, your firm is contracted to explore the implications of the following changes in investment policy and decision-making assumptions:

(1) Changes of assumptions in travel behaviors, such as:

- Value of time

- Willingness to travel

(2) Changes in toll charged for using roads

(3) Changes in revenue elasticity in response to distance traveled, and road standard, e.g., link speed

(4) Changes in elasticity of road maintenance costs in response to road length, flow, and speed

(5) Changes in level of investments based on link performance

Additionally, MnDOT requests that these changes be examined under different network and land use contexts such as:

(1) Different land use density

(2) Different network speed levels

For this project, your firm purchased a network growth simulation software lately developed, called Simulator of Network Growth (SONG 1.0), which has been made available for this course under the following link: http://www.ce.umn.edu/~levinson/Song/Dynamics.html. Your supervisor, Ms. Nelson, assigned you to work on this project, and in two week, you have to get yourself familiar with the software, perform system analysis on the network alternatives under different policy scenarios and decision-making assumptions that MnDOT is interested in, and you must submit a memo to report your findings.

The simulation tool: SONG 1.0

A 30 minutes' instruction will be given to help you learn how to use and understand the underlying model of SONG 1.0. For your brief information, SONG 1.0 is a network growth simulator, developed based on the traditional four-step transportation planning model. It is designed to visualize and enhance better understanding of how transportation networks grow. The policy scenarios MnDOT is interested in have been customized into the software. Additionally, SONG 1.0 contains other policy variables that allow you to adjust to reflect different land use and network situations. Outputs of the simulation include graphical representations of the network volumes and speeds under equilibrium, and a set of system

measurements of effectiveness (MOEs) for further system analysis. In particular, the following MOEs can be generated from the simulation:

1. Average speed
2. Average volume
3. Vehicle Kilometer Traveled (vkt)
4. Vehicle Hours Traveled (vht)
5. Total cost
6. Total revenue
7. Cumulative costs
8. Cumulative revenue
9. Improvement term

Your Tasks

In completing this project, you must fulfill the following tasks:

Task 1: Understand the simulator

Run simulations under default values as well as two of the remaining sets of land use-speed values and interpret the results:

- Base case (default values: uniform land use, uniform speed)

- Uniform land use, random speed

- Random land use, uniform speed

- Random land use, random speed

- Downtown land use, uniform speed

- Downtown land use, random speed

Task 2: Run the simulation under different policy scenarios of interest. (You can adjust values of parameters to reflect different policies or assumptions). Copy the graphic output for your report. (*You can use   copy screen   function of you computer, and then paste the screen with graphic output in a world file*).

Task 3: Perform system analysis based on the MOEs output from the simulation. As an example, a system analysis can contain the following steps:

1) Define the system (e.g., network types, speed, and land use distribution)

2) Generate and assess alternatives available (policy scenarios of interest)

3) Choose alternatives and implement (run simulations)

4) Get feedback (compute and summarize the MOEs)

5) Evaluate and select preferred policy scenarios.

Evaluation can be made based on comparison of the MOEs on certain criteria, for example (you're NOT required to use all of the following criteria):

a.   Effectiveness and Efficiency

- Mobility: Travel time (vht)

- Accessibility: Delay, access to desired locations, access to system

- Reliability: variability of travel time

- Cost-effectiveness: benefit/ cost ratio, outcome benefit per costs

- Consumer surplus

b. Responsibility

- Sustainability: transportation costs

- environmental quality: national/state standard

- Safety and security: accident and crime rate

- Equity: benefit per income group

- customer satisfaction

- economic well being

Also, the following issues should be considered when making the comparisons: scale vs. detail, time frame, boundary effects, short term vs. long term, centralized vs. decentralized, and etc.

Besides method of systems analysis, other analysis methods are also available. You can select analysis methods on your own based on your understanding of how the evaluation should be performed and which methods are applicable to the issues of interest. Examples of other analysis methods include:

- Network analysis model

- Cost/benefit analysis model

- system dynamics model

- probabilistic risk assessment

- Statistical decision theory

- etc.

Task 4: Submit a memo to your supervisor and report your findings.

Recommended outline for your report is as the follow:

1) Problem statement

2) Methodology

- Simulation (briefly describe SONG 1.0 and report your results from Task 1)
- Analysis methodology (stating what and why you choose a particular method)

3) Evaluation and Analysis

4) Results and Findings

5) Discussion of limitations

6) Conclusion

The report must be no more than 2500 words, 1.5 or double spaced, using 12-point Times New Roman font.