1.225J (ESD 205) Transportation Flow Systems

Lecture 13:
Wrap-up
Quiz Review
Subject Evaluation

Prof. Ismail Chabini and Prof. Amedeo Odoni

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Course Wrap-Up

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Cumulative plots and Time-Space Diagrams

- Cumulative plots: *A(t), D(t), Q(t), w(n)* $\Rightarrow$ $\overline{Q} = \overline{\lambda} \times \overline{W}$
- Analysis at a fixed position of time-space diagrams: $\Rightarrow$ $q(x) \approx \frac{1}{\overline{h}(x)}$
- Analysis at a fixed time of time-space diagrams: $\Rightarrow$ $k(t) \approx \frac{1}{\overline{s}(t)}$

Modeling Air Traffic Flows

- Introduction to the modeling of air traffic flows
- An analytical model for arrival capacity of one runway
- Model analysis and practical issues
- Overview of other models for ATM workload, air delays, taxiways and airport terminals

Modeling Road Traffic Flows

- Macroscopic models: fundamental (density vs. flow) diagram
- Microscopic car-following models
- Relationship between macroscopic and microscopic models

Shortest Paths and Assignment on Non-Congested Networks

- Representation of an urban road network (supply)
- Zoning and analysis periods (demand)
- A one-to-all (all-to-one) shortest paths: example and algorithm
- Assignment on non-congested networks: compute shortest paths between O-D pairs, load O-D demands on shortest paths and sum link flows

Traffic Assignment on "Congested" Networks

- Volume-delay functions for "congested" networks and static demand
- Static traffic assignment concepts and principles
  - Concepts: assignment, arc incidence matrix, relationships between path flows and link flows, and link costs and path costs
  - Traffic assignment principles: User Optimal and System Optimal
- User Optimal assignment:
  - All used paths have equal and minimum travel times
  - Equivalent to an imaginary system optimum traffic assignment: link travel time functions are replaced by:
- System Optimal traffic assignment:
  - Total travel times are minimized
  - Equivalent to an imaginary user optimal traffic assignment: link travel time functions are replaced by marginal link travel-times
  - All used paths have equal and minimum marginal travel times

Introduction to Optimization

- Mathematical programs (MPs)
- Formulation of shortest path problems as MPs
- Formulation of U.O. traffic assignment as an MP
- Relationship between U.O. and S.O. traffic assignment
- Relationship between U.O. and S.O. traffic assignment is useful for the development of solution methods

Freeway Traffic Control

- Introduction to freeway traffic control and ramp metering
- Pre-timed, coordinated ramp metering to maximize the number of vehicles served while maintaining freeway capacity: an LP formulation and example

Delays in Probabilistic Models

- Introduction to queuing processes and queuing systems
- Steady state vs. transient state
- Terminology and notation for queuing models
- Little's Law and basic relationships between fundamental variables
- State Transition Diagram for *M/M/1*
- Derivation of queuing characteristics of *M/M/1*

Simulation Models

- Introduction to simulation models
- Random numbers and the inverse transformation method
- Event-driven and discrete-time simulation for *M/M/1* systems
- An event-driven simulation model for *M/M/1* on a spreadsheet

Traffic Signals Control at Isolated Intersections

- Definition of saturation flow rate, effective greens, and lost time
- The three terms of Webster formula for delay at an isolated intersection
- Webster's cycle time setting procedure
- Webster's green time setting procedure

Possible Follow-on Subjects

- Road traffic network models and algorithms (1.207)
- Air traffic control (16.71?)
- Probabilistic models (1.203, 6.431)
- Algorithms (1.204)
- Mathematical programming (15.081)