Course description VT1 2020

TNK118 Traffic Demand Forecasting

Background

Traffic demand modelling is, in practice, to use algorithms and computer software to replicate real world transportation systems. Traffic demand models are used both for describing a current transportation system and for making forecasts of the effects from changes in the system.

In this course, we discuss and analyze the basic building blocks of state-of-the-art traffic demand models, we derive the basic relationships used for demand modeling, and we test the models on small and large-scale examples.

Aim and purpose

The purpose of the course is to provide basic knowledge in planning and forecast modelling of traffic systems. The course provides an overview of problems, settings and applications in the area of traffic planning, and gives insights in how traffic models may be used for analysis of traffic systems with the aim of making the system more efficient, safer and more environmentally friendly now and in the future. Furthermore, the course will help the student to gain insights in the underlying theories on which the models are based. The course covers both supply and demand modelling, and the focus is on demand modelling.

After finishing the course, the student shall to able to:

- Describe the basics for traffic planning and traffic modelling such as trip generation and trip distribution
- Describe and analyze route choice models and assignment methods for network assignment
- Motivate and derive basic discrete choice models
- Apply choice models for modelling demand, mode and route in a traffic network
- Formulate and use trip generation and distribution, route choice, and demand models for evaluating future traffic scenarios
- Estimate parameters in discrete choice models
- Update demand matrices from flow and speed observations
- Make use of tools for applying the models stated above

Organization

The course consists of 13 lectures, 7 seminars and 2 computer exercises.

Content and literature

The course covers the following topics:

- Introduction to traffic planning and traffic simulation
- Classification of traffic models
- Route choice model and assignment principles for network assignment
- Experiments with network assignment models
- Discrete choice models
- Parameter estimation for choice models
- OD-estimation
- Application of the traffic forecasting models on capacity and pricing problems

The following literature will be used during the course:

- Traffic Demand Modelling, Immers and Stada, 1998. (https://www.mech.kuleuven.be/cib/verkeer/dwn/H111part1.pdf)
- Modelling Transport by Ortuzar and Willumsen, 4th edition, 2011. (Library)
- Urban Transportation Networks: Equilibrium Analysis with Mathematical Programming Methods, Sheffi, 1985. (http://sheffi.mit.edu/book/urban-transportation-networks)
- Travel Demand Models – A Survey, from Optimization Approaches to Travel Demand Modelling, Lundgren, 1989. (LISAM)
- A Self Instructing Course in Mode Choice Modeling: Multinomial and Nested Logit Models, Koppelman and Bhat, 2006. (http://www.caee.utexas.edu/prof/bhat/COURSES/LM_Draft_060131Final-060630.pdf)

Excerpts from the above will be used. A detailed description of which pages that will be used is given in the course plan below. Additional texts are referred to during the lectures.

Course plan

- Tuesday, 2020-01-21, 10:15 - 12:00, TP31, LE1: Introduction
  - Analysis of the transportation system (Chapter 1 and 2, Immers and Stada, 1998)
  - Examples of demand modeling systems (Slides)
  - Course description walkthrough (Slides)
- Wednesday, 2020-01-22, 13:15 - 15:00, TP40, LE2: Trip generation
  - Demand and supply on the transport market (Chapter 1, Immers and Stada, 1998)
  - Structure of the traditional traffic demand model (Chapter 2, Immers and Stada, 1998)
  - Production and attraction and trip generation (Chapter 5.1-5.5, Immers and Stada, 1998)
- Friday, 2020-01-24, 08:15 - 10:00, TP31, LE3: Trip distribution
  - Intro to trip distribution (Chapter 1-2.1, Lundgren, 1989)
  - Mathematical modeling of the gravity model (Chapter 1-2, Lundgren (1989)
- Monday, 2020-01-27, 08:15 - 10:00, TP4027, SEM1: Trip generation and distribution (Computer lab)
  - Exercises (Handout on LISAM)

- Tuesday, 2020-01-28, 10:15 - 12:00, TP31, LE4: Discrete choice 1
    - Koppelman and Bath (2006), Chapters 3 and chapters 4 to 4.3
- Wednesday, 2020-01-29, 13:15 - 15:00, TP32, LE5: Discrete choice 2
    - Koppelman and Bath (2006), Chapter 4.4.
- Friday, 2020-01-31, 08:15 - 10:00, TP40, SEM2: Logit 1
    - Exercises (Handout on LISAM)
- Monday, 2020-02-03, 08:15 - 10:00, TP40, LE6: Discrete choice 3
    - Koppelman and Bath (2006), Chapter 4.4.
- Wednesday, 2020-02-05, 13:15 - 15:00, TP40, LE7: Discrete choice 4
    - Nested Logit models (Koppelman and Bath, 2006, Chapters 8 and 9)
- Wednesday, 2020-02-05, 15:15 - 17:00, TP31, SEM3: Logit 2
    - Exercises (Handout on LISAM)
- Friday, 2020-02-06, 08:15 - 10:00, TP40, LE8: Discrete choice 5
    - Nested Logit parameter estimation (Koppelman and Bath, 2006, Chapters 8 and 9)
- Monday, 2020-02-10, 08:15 - 10:00, TP4003, SEM4: Logit 3 (Computer)
    - Exercises (Handout on LISAM)
- Wednesday, 2020-02-11, 13:15 - 17:00, TP5021, CE1: Discrete choice
    - See Submission on LISAM
- Friday, 2020-02-14, 08:15 - 10:00, TP31, LE9: Network assignment 1
    - Supply modelling (Immers and Stada, 1998, Chapter 8.1-8.1.7)
- Monday, 2020-02-17, 08:15 - 10:00, TP31, LE10: Network assignment 2
    - Network equilibrium (Sheffi, 1985, Chapters 1, 3)
- Tuesday, 2020-02-18, 10:15 - 12:00, TP31, LE11: Network assignment 3
    - Computing equilibria (Sheffi, 1985, Chapters 5.1-5.2)
- Thursday, 2020-02-20, 10:15 - 12:00, TP4005, SEM5: Network assignment 1 (Computer)
    - Exercises (Handout on LISAM)
- Friday, 2020-02-21, 8:15 - 10:00, TP301, SEM6: Network assignment 2
    - Exercises (Handout on LISAM)
- Wednesday, 2020-02-26, 13:15 - 17:00, TP4005, CE2: Network assignment
    - See Submission on LISAM
- Friday, 2020-02-28, 08:15 - 10:00 TP31, LE12: OD-calibration
    - Lundgren (1989), Chapter 2.3, 3.3
    - Ortuzar and Willumsen (1990), Chapter 12.4-12.4.6
- Tuesday, 2020-03-03, 10:15 - 12:00, TP5021, SEM7: OD-calibration (Computer)
    - Exercises (Handout on LISAM)
- Tuesday, 2020-03-10, 10:15 - 12:00, TP31, LE13: Course summary / Spare slot
- Written exam 2020-03-20, 8:00 – 12:00

Examination

The examination consists of a written exam and completed computer exercises, individual and in groups of two students, respectively. The written exam covers theory, mathematical derivations and computations.

Course material, including lecture slides and instructions for the computer exercises are published at LISAM, http://lisam.liu.se. All documents produced shall be uploaded under the appropriate assignment at LISAM. The computer exercises shall be answered in English.

The written exam is given March 20, 2020, 8:00-12:00. First re-examination is given May 31, 2020, 8:00-12:00. The exam can be answered in English or Swedish.

Examiner

The course examiner and lecturer is Clas Rydergren, clas.rydergren@liu.se, Spetsen floor 8, phone 011-363314. The computer exercises are supervised and corrected by Alan Kinene, alan.kinene@liu.se, Spetsen floor 6, 011-363299.