

## Course Public Transport

<b>Date:</b>	<b>22 April, 6 &amp; 20 May, 3 June 2015</b>
<b>Time:</b>	<b>10.00 – 16.00 h.</b>
<b>Location:</b>	<b>Schiphol, Dinalog, Evert van de Beekstraat 356, SADC (2nd floor), Building C</b>
<b>Course leader:</b>	<b>Prof. dr. Leo Kroon and Dr. Dennis Huisman</b>
<b>ECTS:</b>	<b>4 (1 for Attendance; 3 for Assignments)</b>
<b>TUD GS credits:</b>	<b>2 (attendance) - 5 (attendance + assignment)</b>
<b>Days:</b>	<b>4</b>
<b>Course fee:</b>	<b>Free for TRAIL/Beta/OML/ERIM members, others please contact the TRAIL office</b>
<b>Registration:</b>	<b>info@rstrail.nl</b>

### Objectives

The students will learn:

- Models for analysing passenger behaviour, for forecasting passenger demand, and for providing passenger information.
- Mathematical models and solution approaches for supporting the planning and real-time operations of public transport systems, in particular network design, timetabling, vehicle and crew scheduling.

### Course description

The aim of this course is to learn how to plan and control the operations in public transport systems. We focus on how to design and apply mathematical models and solution approaches to deal with typical decision problems that arise in public transport systems to make sure that certain objectives are met. We consider various decision problems at the strategic (network design, demand forecasting, capacity planning), tactical (timetabling, resource allocation) and operational levels (vehicle and crew scheduling). Several approaches for dealing with the inherent uncertainty in public transport systems will be presented, among which simulation, and stochastic and robust optimization.

### Assignment

Two assignments are to be made in between classes to show an understanding of the concepts discussed and to apply these in a small research projects. One assignment will be on network design/timetabling. The other assignment will be on vehicle/crew scheduling.

### Program (preliminary)

April 22 Introduction. Models and solution techniques for network design. Models for analysing passenger behaviour and for demand forecasting.  
 May 6 Models and solution techniques for timetabling problems.  
 May 20: Models and solution techniques for vehicle and crew scheduling.  
 June 3: Real-time operations control; delay and disruption management.

### Course material

A number of academic papers, including:

- D. Huisman, L.G. Kroon, R.M. Lentink and M.J.C.M. Vromans. Operations Research in Passenger Railway Transportation, *Statistica Neerlandica* 59, 467-497, 2005.
- Line planning in public transportation:
- A. Schöbel. Line Planning in Public Transportation: Models and Methods. *OR Spectrum*, 34:491–510, 2012.
- L.G. Kroon, D. Huisman, E.J.W. Abbink, P.-J. Fioole, M. Fischetti, G. Maróti, A. Schrijver, and A. Steenbeek, and R.J. Ybema. The New Dutch Timetable: The OR Revolution, *Interfaces*, 39, 6-17, 2009.
- C. Liebchen and R.H. Möhring. The Modelling Power of the Periodic Event Scheduling Problem: Railway Timetables and Beyond. Algorithmic Methods for Railway Optimization, Volume 4359, Lecture Notes in Computer Science Eds: F. Geraets, L.G. Kroon, A Schöbel, D. Wagner, and C.D. Zaroliagis. Springer Berlin Heidelberg, 2007.
- P.-J. Fioole, L.G. Kroon, G. Maróti and A. Schrijver, A Rolling Stock Circulation Model for Combining and Splitting of Passenger Trains, *European Journal of Operational Research* 174, 1281-1297, 2006.
- D. Huisman, R. Freling and A.P.M. Wagelmans, Multiple-Depot Integrated Vehicle and Crew Scheduling, *Transportation Science* 39, 491-502, 2005.
- D. Potthoff, D. Huisman and G. Desaulniers, Column Generation with Dynamic Duty Selection for Railway Crew Rescheduling", *Transportation Science* 44, 493-505, 2010.
- E.J.W. Abbink, L. Albino, T.A.B. Dollevoet, D. Huisman, J. Roussado and R.L. Saldanha, Solving Large Scale Crew Scheduling Problems in Practice, *Public Transport* 3, 194-164, 2011.
- V. Cacchiani, D. Huisman, M. Kidd, L.G. Kroon, P. Toth, L.P. Veelenturf, and J. Wagenaar: An Overview of Recovery Models for Real-time Railway Rescheduling. *Transportation Research Part B* 63, 15-37, 2014.
- A. Schöbel. *Integer Programming approaches for solving the delay management problem*. Algorithmic Methods for Railway Optimization, Volume 4359, Lecture Notes in Computer Science Eds: F. Geraets, L.G. Kroon, A Schöbel, D. Wagner, and C.D. Zaroliagis. Springer Berlin Heidelberg, 2007. 145-170.
- E. van der Hurk, G. Maroti, L.G. Kroon, and P.H.M. Vervest. Deduction of Passengers' Route Choice from Smart Card Data. *IEEE Transactions on Intelligent Transportation Systems*.

### Prerequisite

A solid knowledge of mathematical optimization models and solution techniques is required.