Programme doctoral en recherche opérationnelle

Zinal Seminar 2013, January 13-17

	Sunday 13	Monday 14	Tuesday 15	Wednesday 16	Thursday 17
07:30 - 08:30		Breakfast	Breakfast	Breakfast	Breakfast
08:30 - 10:00		Wallace	Crainic	Wallace	Crainic
10:00 - 10:30		Coffee	Coffee	Coffee	Coffee
10:30 - 12:00		Crainic	Wallace	Crainic	Wallace
12:00 - 17:00		Sport and dicussions			
17:00 - 17:30		Hertz	Vargas	Respen	
17:30 - 18:00			Papapanagiotou	Toklu	
18:00 - 18:30	Welcome cocktail		Isaksson	Thevenin	
18:30 - 19:00			Newman	Bock	
19:30	Dinner	Dinner	Dinner	Dinner	

Venue:
Hotel Europe
3961 Zinal
Tel.: 027 475 44 04

Keynote presentations

Teodor Crainic (Université du Québec à Montréal)

Title: **Network design and the planning of transportation systems**

Abstract: This series of lectures will focus on fixed-cost capacitated multicommodity network design problems and applications to the planning of transportation systems. We are given a potential network, that is, nodes and arcs linking them, as well as a demand for transportation taking the form of volumes of particular flows - the commodities - to be moved between specific pairs of origin and destination nodes. Each arc is characterized by a fixed cost, to be paid if the arc is selected/used in the final design, variable unit costs for commodity flows, and capacity measures limiting the amount of flow one can move through the arc. Network design aims to select among these potential arcs (and nodes), the set of arcs (and nodes) of a final network able to satisfy the demand at minimum total (fixed and variable) cost. Network design is a core combinatorial optimization problem and we will start with a brief overview of formulations, properties, and algorithmic approaches. It is also the formulation of choice for important applications in many fields, the planning of transportation services, in particular. Called the service network design problem, its goal is to select services (the arcs) to be offered by a transportation carrier, the frequency or schedule of these services over the planning horizon, the freight and vehicle classification and consolidation policies at terminals, as well as the commodity itineraries through the resulting service network. We will examine a number of major problem settings, starting with the classic static one, then considering congestion phenomena (which yield non linear formulations), time-dependencies and scheduling issues, to finally discuss the integration of resource management issues, traditionally considered an operational-level planning issue, into tactical planning service network design models. In all cases, we will discuss the issues and emphasize the modelling aspects, while also touching on how to algorithmically address the associated network design formulations.

Alain Hertz (École Polytechnique de Montréal)

Title: **Vertex coloring: from a standard model to more realistic ones.**

Abstract: The vertex coloring problem is to assign a color to the vertices of a graph so that no adjacent vertices share the same color, and the total number of colors is minimized. This standard combinatorial optimization problem enjoys many practical applications, but it must often be extended to model more complex real life applications. We will discuss some extensions of this classical problem, including bandwidth coloring, interval coloring, robust coloring and weighted coloring.

Stein W. Wallace (Norwegian School of Economics)

Title: **Stochastic programming with an emphasis on modeling**

Abstract: The main focus in these lectures will be modeling using stochastic programming. We shall discuss (the failure of) sensitivity / what-if analysis, as well as take a look at competing modeling concepts in an attempt to find the role of stochastic programming. We shall also try to understand which stochastic problems

are relatively easy, and which are not. After this introduction, we'll turn around and ask: Even if deterministic solutions are bad (and they normally are), could they carry useful information? In this context we shall dwell for quite a while on network design. The next part will be to understand why scenario generation (i.e. discretization of random variables) can be crucial, despite possibly not interesting us at all, and we shall look into some of the basic ideas of how to know if we have a good method. Finally, we shall define the basic format of a two-stage stochastic program and outline the L-shaped decomposition method.

PhD presentations

Adrian Bock (EPFL)

Title: **Capacitated orienteering**

Abstract: In the capacitated Orienteering problem, we are given an undirected metric graph, starting and end nodes s, t, node profits and node demands, a length bound D and a capacity bound C. The goal is to find an s-t path of length at most D that collects maximum profit from nodes whose total demand does not exceed the capacity bound C. We give a constant factor approximation algorithm for general graphs. For both trees and euclidean graphs we get a PTAS. These results generalize the corresponding results for the uncapacitated version that are known. As one may expect, there is a number of capacitated vehicle routing problems where the capacitated orienteering problem appears as subroutine. As a byproduct of our analysis, we develop efficient approximation algorithms for some of those problems.

Olov Isaksson (EPFL)

Title: **Quantifying the bullwhip effect using two-echelon data: a cross-industry empirical investigation**

Abstract: The bullwhip effect is said to occur when demand variability is amplified from a downstream site (buyer) to an upstream site (supplier) in the supply chain. This paper contributes to the literature that empirically investigates the bullwhip effect by providing new evidence regarding its existence and magnitude. In contrast to previous work, we use a two-echelon approach, which allows us to observe variations at both the upstream and the downstream sites. By drawing on a financial accounting standard regarding information disclosure about major customers, we are able to link 5,494 buyers-supplier dyads between 1976 and 2009. We merge this information with quarterly financial accounting data to form a sample of 14,933 buyer-supplier dyad observations. We correct for size differences and sample selection bias using propensity score matching and estimate the average bullwhip effect in our sample to be 90%. A significant bullwhip effect is found across industries (mining, manufacturing, wholesale and retail) and is supported by several robustness checks. We investigate and discuss how these results can be generalized beyond our sample.

Alantha Newman (EPFL)

Title: **How to use complex semidefinite programming for max-k-cut**

Abstract: A little more than a decade ago, Goemans and Williamson showed how to formulate and round a complex semidefinite program (CSP) to give the best-known approximation guarantee for the Max-3-Cut problem. They left open the problem of how to apply their techniques to the Max-k-Cut for general k. They point out that it does not seem staightforward or even possible to formulate a good quality complex semidefinite program for the general problem, which presents a barrier to the application of their techniques.
While other works (e.g by Frieze and Jerrum) have analyzed other semidefinite programming based algorithms for the Max-k-Cut problem and these algorithms are

quite simple, their analyses are quite complicated. We will discuss how the tools from Goemans and Williamsons CSP paper can be applied to the Max-k-Cut problem for general k, which leads to weaker approximation guarantees but to an arguably simpler analysis.

Vassilis Papapanagiotou (University of Lugano and IDSIA)

Title: **A sampling-based approach for the orienteering problem with stochastic travel and service times (joint work with D. Weyland, R. Montemanni, L.M. Gambardella)**

Abstract: In this presentation, a variant of the orienteering problem in which the travel and service times are stochastic, is examined. Given a set of potential customers, a subset of them has to be selected to be serviced by the end of the day. Every time a delivery to a selected customer is fulfilled before the end of the day, a reward is received, otherwise, if the delivery is not completed, a penalty is incurred. The target is to maximize the expected income (rewards-penalties) of the company. In this presentation a Monte Carlo sampling-based approach is used to calculate the objective function yielding great benefits in speed with minimal loss in accuracy. Additionally, a local search algorithm tailored for solving the problem, is proposed. Finally, experimental results and a comparison with state-of-the-art methods are presented.

Jean Respen (University of Geneva)

Title: **A complex truck loading problem proposed by the French car manufacturer Renault**

Abstract: To deliver goods to car factories, Renault is daily facing a complex truck loading problem where various goods must be packed in a truck such that they fulfill different constraints. As trucks can deliver goods to different factories on the same run, classes of items have been defined, where a class represents a delivery point. As the number of items is large and the standard deviation of the sizes of the items is significant, no exact algorithm is competitive. In this talk, a descent algorithm and three tabu search metaheuristics are proposed to tackle this problem. The obtained results are discussed and favorably compared to the ones provided by Renault.

Andres Ruiz Vargas (EPFL)

Title: **Empty triangles in topological graphs**

Abstract: We will show that the number of empty triangles in complete topological graphs is at least 2n/3.

Simon Thevenin (University of Geneva)

Title: **Heuristics for a k-multi-coloring problem with rejections**

Abstract: We consider the problem of preemptively schedule n jobs on an unbounded number of parallel machines. To process a job, machines need to be equipped with different tools. Two jobs which necessitate the same tools are incompatible

and cannot be performed simultaneously. Moreover, a global deadline is given: no job can be scheduled after this date. We consider the case where it is not possible to schedule all jobs. Three objectives are considered in a lexicographic approach: (1) maximize the gain associated with completely performed jobs; (2) minimize the number of preemptions; (3) minimize the work in progress inventory. The problem is modeled as an extension of the k-multi-coloring problem: taking advantage on the associated existing literature, we propose an efficient tabu search approach to solve the considered problem.

Nihat Engin Toklu (University of Lugano and IDSIA)

Title: **An ant colony system approach for a capacitated vehicle routing problem with uncertain travel costs (authors: N.E. Toklu, R. Montemanni, L.M. Gambardella)**

Abstract: In this presentation, we study a capacitated vehicle routing problem with uncertain travel costs. We assume that we do not know the probability distributions for these travel costs, we only know that they are bounded. Therefore, the travel costs are expressed as interval data. For solving this problem, we propose a metaheuristic approach which evaluates candidate solutions from a robust optimization perspective. In more details, we base our approach on an ant colony system, a metaheuristic which was originally developed for the deterministic (i.e. non-robust) version of the capacitated vehicle routing and we modify the algorithm to incorporate an objective function which calculates the cost by using the robust optimization formulations proposed by Bertsimas/Sim. After discussing the robust ant colony system, we present our analysis on the price of robustness: the effects of the different levels of conservatism (i.e. protection against the uncertainty) on the solutions.