

The Livestock Collection Problem

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The Livestock Collection Problem (LCP) is a rich, real-world, routing problem where several constraint sets at the route level are combined with global inventory constraints. The problem is taken from the Norwegian meat industry, and deals with transportation of live animals from farms to a slaughterhouse.

Our version of the LCP is based on the well-known Vehicle Routing Problem (VRP). Many of the standard extensions to the basic model are added, such as a heterogeneous vehicle fleet, duration constraints and precedence constraints. Constraints on how animals of different species, genders and sizes may be mixed in the same compartment on board the same vehicle also have to be added. These constraints on mixing of animals lead to a situation where the capacity of each vehicle depends on the visiting order of the farms on each tour, meaning that one also gets a packing or loading problem to handle.

In addition to the routing constraints, global constraints on the number of animals kept in inventory has to be added. The lairage at the slaughterhouse has a limited capacity, and the animals cannot stay there for more than one day. The lairage serves as a temporary storage between farmer and slaughtering, and there must always be enough animals in the lairage to keep the slaughtering go as planned.

A mathematical model for our version the LCP can be formulated in about 40 lines, and in addition to being large, this model includes a lot of binary variables and non-linear constraints that make it impossible to solve exactly for instances of realistic size. We have developed a Tabu Search based heuristic for the LCP, in addition we have used a column generation approach to solve small instances to optimality. Results from both methods are presented.

In order to make practical use of the results from the project, there are plans to implement the main results in an industrial solver.