Forest harvesting with mobile sawmills

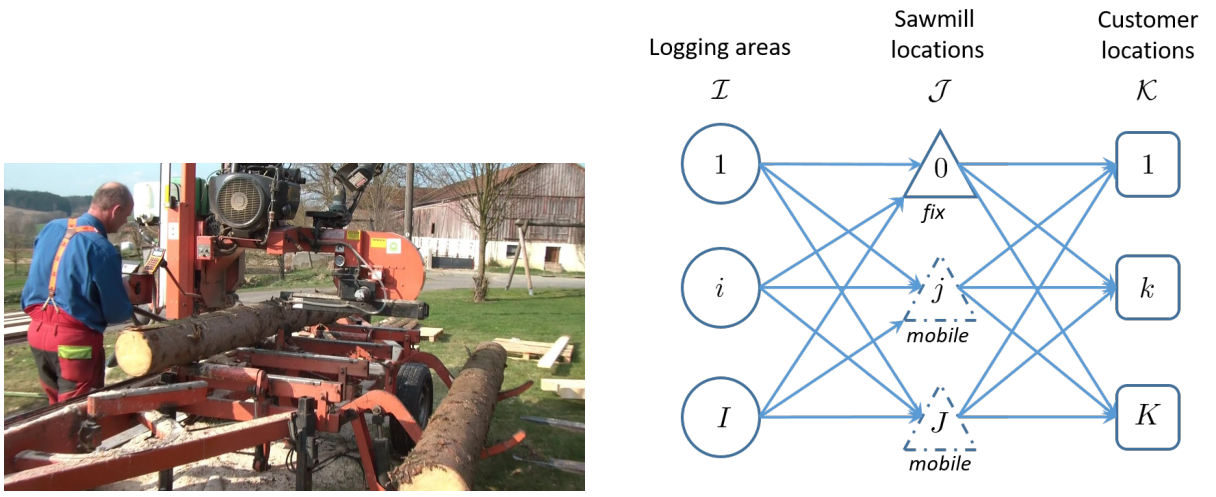
1. Problem description

The management of commercial timberland involves the regular harvesting of trees. Next to industrial customers like the paper industry, often wood farmers deliver timber and timber products to private customers in the region of the timberlands (e.g., for heating). The forest harvesting process can be described as follows: 1) harvest trees, 2) transport to sawmill, 3) cutting trunks into timber products, and 4) transport timber products to customers.

Typically, sawmills are immobile and remain at fixed locations. However, in recent years, many forest farmers have invested in smaller mobile sawmills which can be transported to the logging areas.

In each logging area, trees of different species grow and can be cut to serve the customers. In each logging area, there is a central landing space where the cut trees are stored temporarily. At the landing spaces the mobile sawmill can be located to cut the corresponding raw logs into timber products. Otherwise, trucks fetch the raw logs from the landings and transport them to the sawmill.

Transporting the sawmill requires special trucks. Likewise, the raw logs need to be transported by special trucks while the timber products can be transported with ordinary freight transporters. Figure 1 shows a mobile sawmill and a schematic description of the forest harvesting process.



(a) Mobile sawmill

(b) Forest harvesting process

Figure 1: Mobile sawmill and forest harvesting

The timber products sold to the customers are characterized by two attributes: a) The tree species and b) the cutting form. Each customer places orders that consist of a specific cutting

form, the species of the tree and the quantity expressed in cubic meters (cm). The logging areas are inspected regularly such that for each area it is known which quantities of the different timber products can be extracted from each area.

2. Task

For this project data from a real harvesting area are provided. The files “supply.csv” and “demand.csv” contain information about the quantities of timber products to be found in the logging areas as well as the orders placed by the customers. The files “dist_hefs.csv” and “dist_hefs_customers.csv” contain the distances in meters between the logging facility (node 0) and the logging areas as well as the customer locations. It is assumed that the transport cost rate for transporting the sawmill is 0.75 € per km. The transport cost rate for transporting raw logs to the sawmill are 0.4 € per km and truck. Trucks for raw logs can carry 250 cm of raw logs. Transports of final timber products to customers cause transport cost of 0.1 € per km whereby each transporter can carry 100 cm (independent of the type of timber product).
Compile a report that first contains a descriptive analysis of the timber products that can be extracted from the logging areas along with an overview on the tree species grown in the logging areas. Subsequently, derive a optimization model that helps the management to determine where to put the sawmill and how transport raw logs as well as the timber products such that total transport cost are minimized.