

### Exercise 44-1 - Økobilen

Økobilen is a small-sized company located in Aarhus owned by Erik Jørgensen. The company sell organic fruits and vegetables to companies and private persons. Using the company's web-page each customer can order different packages of fruits/vegetables. Orders can be both one-time, daily, weekly and monthly.

The company's business concept is centred around day to day delivery directly to the customer and competitive prices on high quality fruits/vegetables. A web-based ordering system is used which help keeping the administrative costs low.

Early each morning the list of today's orders is received from the ordering system and fruits and vegetables needed for the orders are packed into one-size boxes at Økobilen's domicile located outside Aarhus. Afterwards each order is distributed to the customer. The company currently own a mid-sized van with a capacity of 50 boxes which is used to distribute the boxes each day. The average speed of the truck is 60 km/hour with a cost of 4 DKK per km. It is left to the driver of the truck to decide in which sequence to deliver the orders. Loading and unloading takes approximately 5 minutes.

Currently, Økobilen has 32 active customers located near Aarhus; however, the company has a high rate of success in getting new customers. Moreover, it seems that the customers are quite loyal to the company. An overview over the customers can be seen in Figure 1

Answer the following questions. Data about customers and orders are available in the supplied zip file. You can load them using the "Import CSV" menu on logvrp.com.

- a) For the next 4 days get an overview over orders and find suggestions on good routing strategies. Give a plot of the best known routing strategy for day one. Make a table summarizing the results for the next 4 days (orders, total distance, cost, travel time, number of trips/cycles).
- b) Assume that the driver each morning starts his route from the depot at 7 o'clock. Moreover, his closing-time is at 3 o'clock in the afternoon. Is the routes found for each day feasible?

In the light of Økobilen's success the owner plan to promote the company using an advertising campaign. The campaign will try to attract new customers as far as 80 km from Aarhus. As a result he expect the numbers of customers to increase rapidly in the next year. This require more focus on the planing and transportation processes. Erik has written down the following questions/ideas

- Better/faster packing of the fruits is needed. How?
- Should I hire a new driver/buy a new truck?
- Idea: Better service - make customers choose delivery time.
- Idea: Better service - delivery to firms in the morning/early afternoon and delivery to private persons in late afternoon/evening.

To analyse some of Erik's questions/ideas consider the scenario where the number of customers increase from 32 to 64 and the demand pattern looks like given in the four csv files (see zip file).

- c) Try to solve the routing problem for day one for the new customer group. Is the route feasible? What should Erik do?



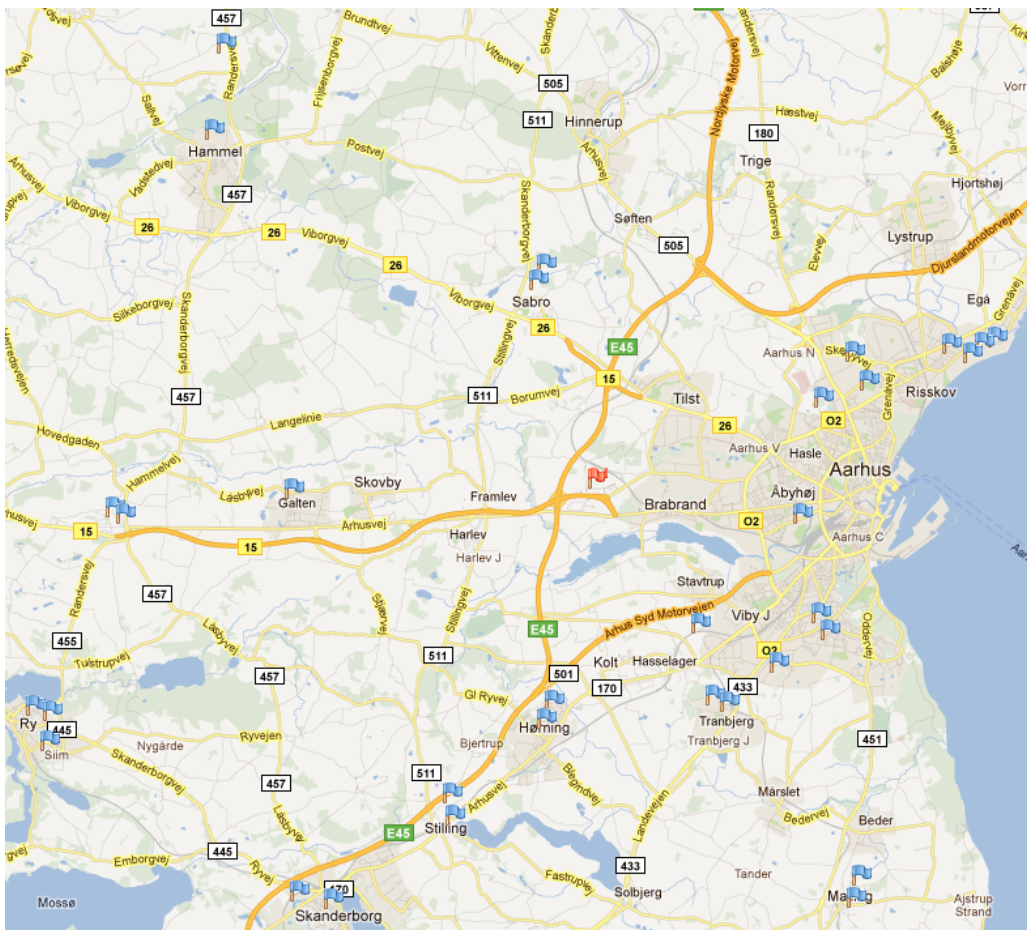


Figure 1: Customers (blue) and Økobilen's domicile (red).

- d) Assume that Erik choose to increase the number of vehicles in the company and hire more drivers. He may either buy vehicles of the same type as the one currently in operation or buy a small trucks with a capacity of 100, average speed of 50 km/h and a cost of 5.5 DKK/km. Which and how many vehicles should he buy given that 1) all vehicles start at 7:00 or 2) two drivers use the same vehicle (one starts at 7:00 and the other at 15:00), i.e. we do not have to buy so many vehicles.
- e) Consider the idea about splitting customers in two groups (firms and private). Approximate 50% of the customers are firms. Data files for splitting orders and customers are given in the zip file. Is it a good idea to improve service by delivery to firms in the morning/early afternoon and delivery to private persons in late afternoon/evening?
- f) Based on the above answers write down a short conclusion. What you suggest the company should do? Take also into consideration the possibility of using a 3PL (pros and cons).