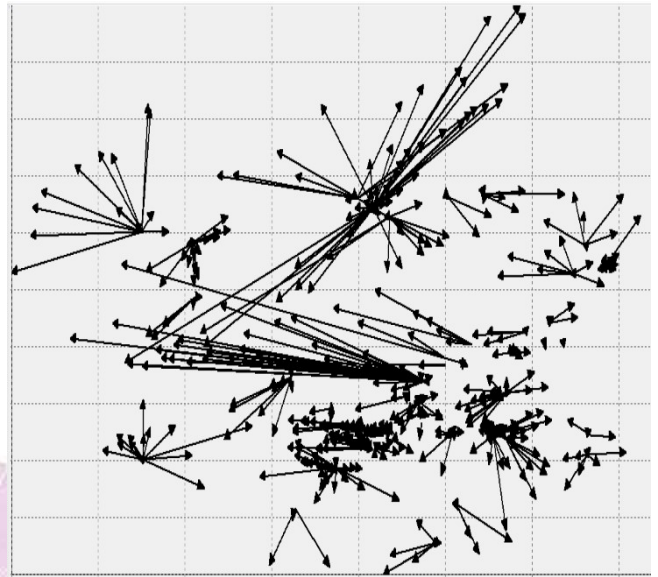
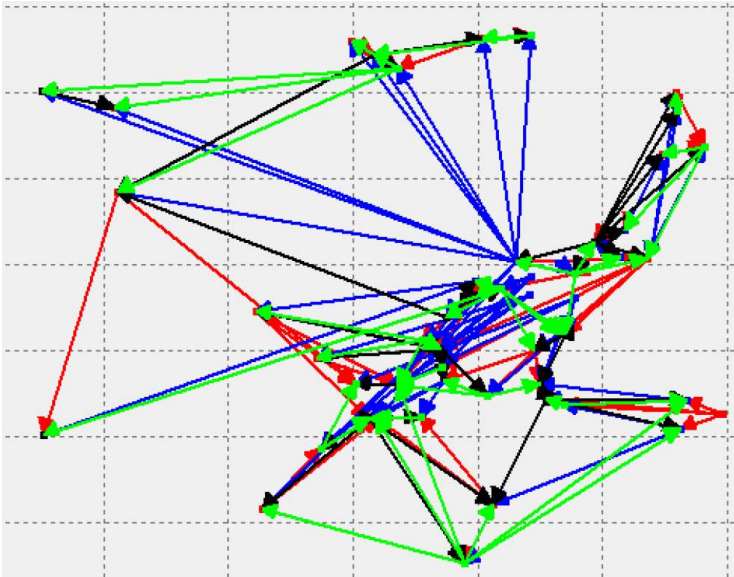




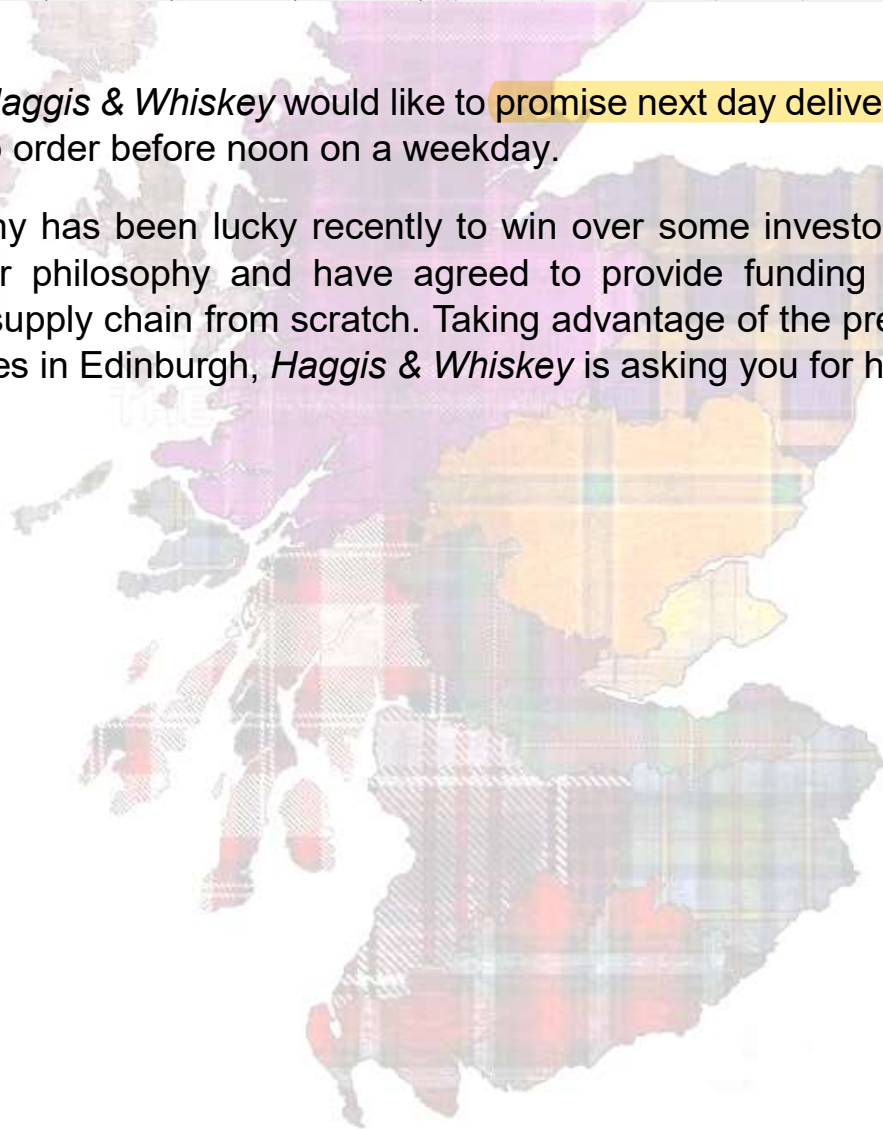
*Haggis & Whiskey* is an established company in Scotland that runs under the philosophy: *Think Global! Buy Local!* The company provides an online platform to sell Scottish products to individuals and small shops in Scotland, predominantly fresh produce, like vegetables, dairy products, meat and fish, but also soft and alcoholic drinks, and ambient food. They are serving all of Scotland, with the exception of Shetland. Over the years, the company has built up a network of sustainable producers, including farmers, manufacturers, and breweries, that have agreed to make a certain percentage of their annual production available to *Haggis & Whiskey*.

Unfortunately, *Haggis & Whiskey* have been quite naïve when setting up their logistics chain over the years. They have either built or rented a small warehouse at every producer's location, from which they then serve the customer demands. *Haggis & Whiskey* takes care of its customers and to minimize their inconvenience, they decided two years ago that the complete order has to arrive in one single shipment from a warehouse. However, to facilitate this policy, every warehouse now needs to stock all products, which not only results in frequent stock-outs because of limited capacity, but also means that products have to be shipped over long distances. This is not just economically inefficient, but also results in a larger than necessary carbon footprint. The following pictures illustrate the current network of shipments between warehouses (left-hand side) and between warehouses and customers (right-hand side).



Moreover, *Haggis & Whiskey* would like to promise next day deliveries for customers who order before noon on a weekday.

The company has been lucky recently to win over some investors who believe in their philosophy and have agreed to provide funding for re-designing the supply chain from scratch. Taking advantage of the presence of ESI Laureates in Edinburgh, *Haggis & Whiskey* is asking you for help.

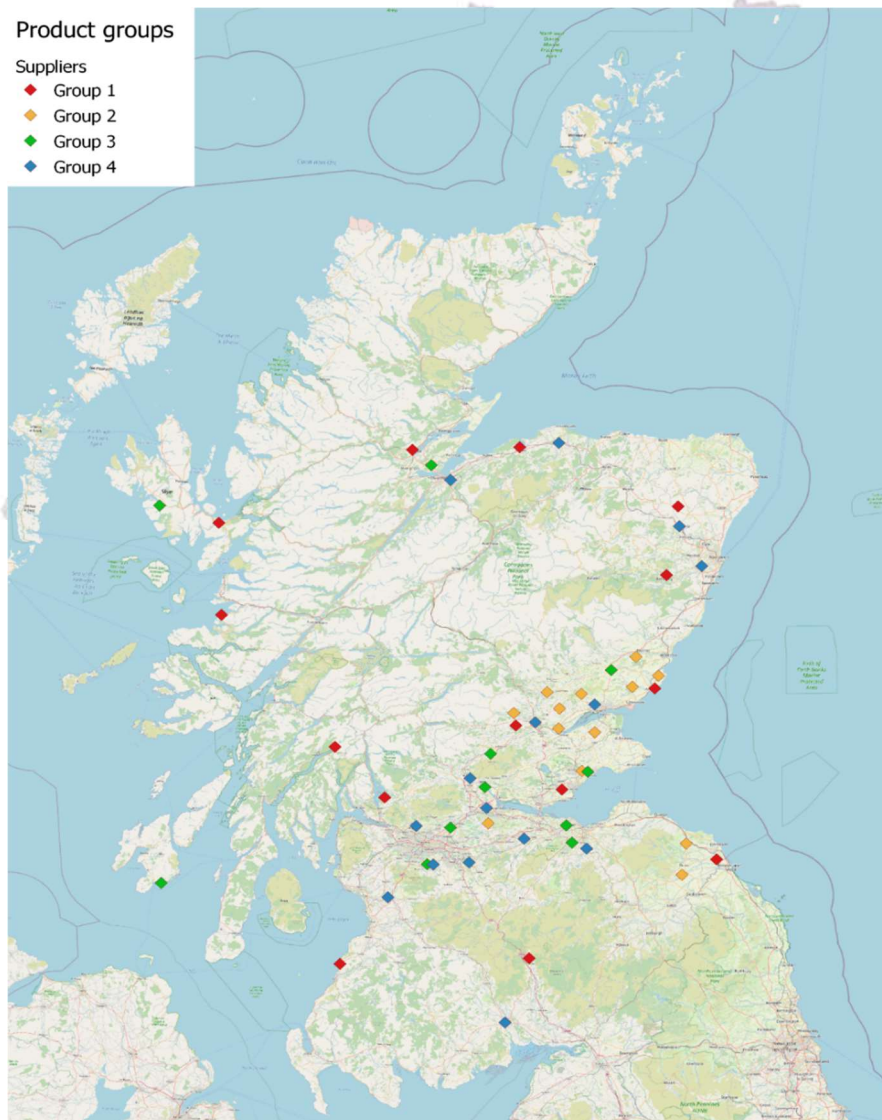




# Details about Haggis & Whiskey's operations

## Suppliers

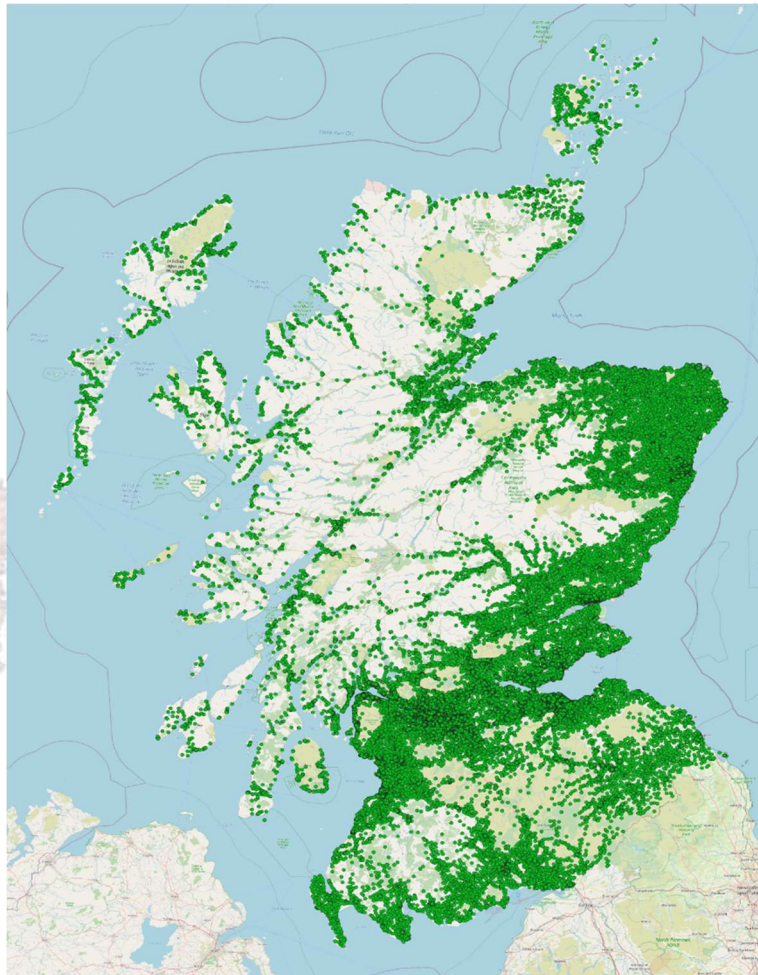
*Haggis & Whiskey* has grouped their products into four categories based on some key characteristics (e.g. needs cooling, drinks). Each producer can only provide products from a single product group. The locations of the producers, coloured by product group, are shown in the following picture.



The spreadsheet *Suppliers.xlsx* contains for each producer its respective product group and the total annual production volume in kg that *Haggis & Whiskey* has secured. Suppliers that are located in remote parts of the country and/or have a low capacity must be served by 7.5t trucks (see the section on **Transportation** for more details on vehicles).

## Customers

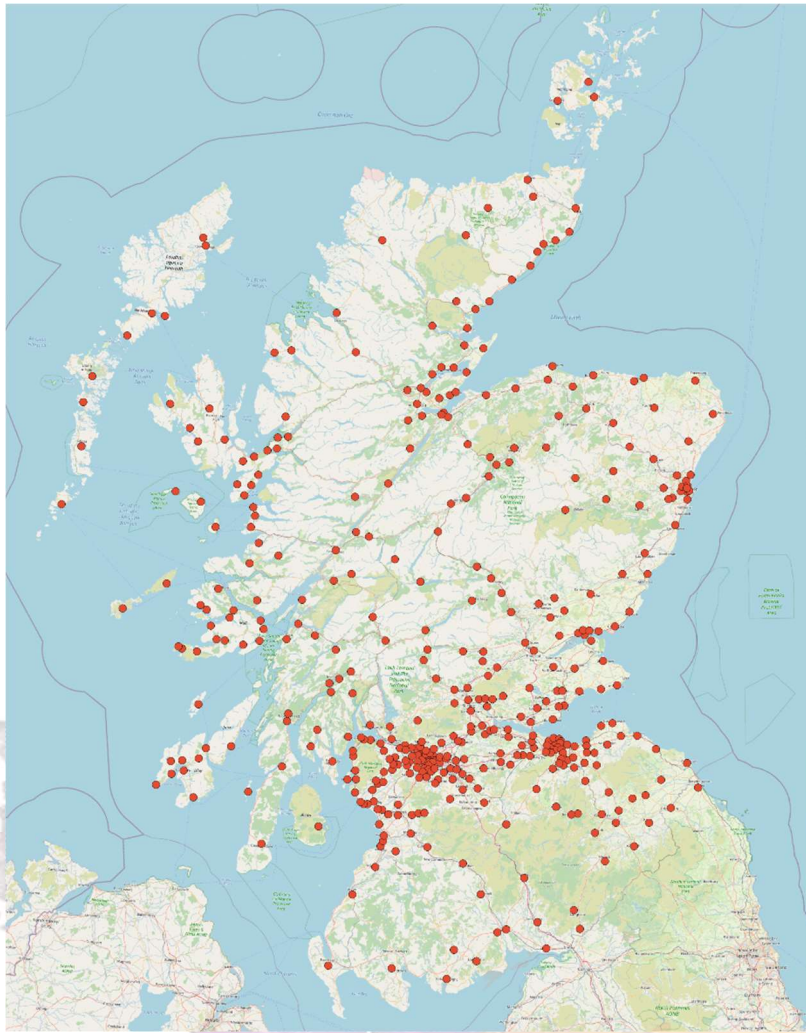
Any household and small shop is a potential customer. The following map depicts all postal codes in Scotland as a dot (~157,000).



To simplify the planning, *Haggis & Whiskey* has agreed to use postal districts instead of postcodes. There are 440 postal districts in Scotland, which are shown on the following page.

Unfortunately, their database server has crashed about a year ago and all data on past orders was lost. As a result, they only have the sales data for the past twelve months. The annual sales volume in kg per district is given in columns J – M of the spreadsheet *Postcode Districts.xlsx*. The spreadsheet also contains, among other things, the x- and y-coordinates of the district centre and the district's population.





## Transportation

*Haggis & Whiskey* has a large fleet of 3.5t vans, 7.5t lorries, and 18t trucks already in operation and ready to use. As neither 7.5t lorries nor 18t trucks are suitable for door-to-door deliveries in cities or small villages, shipments from warehouses to customers can only be carried out using the 3.5t vans.

The transportation cost per mile and ton for the three vehicles types is £0.09 for 18t trucks, £0.226 for 7.5t lorries and £0.362 for 3.5t vans. Moreover, the CO2 emissions per mile and ton are 0.05kg for 18t trucks, 0.1kg for 7.5t lorries, and 0.13kg for 3.5t vans.

The road distance in miles between suppliers and postal districts and between postal districts are given in the spreadsheets *Distance Supplier-District.xlsx* and *Distance District-District.xlsx*. Do not forget that vehicles must travel both directions.

## Warehouses

The setup costs in pounds for warehouses at the different locations is given in the spreadsheet *Warehouses.xls/x*. This includes the construction cost and the operating cost for the whole planning horizon (see below). Moreover, it contains the annual warehouse handling capacity in kg.

## The new supply chain

*Haggis & Whiskey's* management has decided to abandon all warehouses at the suppliers and rebuild the supply chain from scratch. All customers in a postal district must be served from the same warehouse. Moreover, from a logistical point of view it might be sensible to serve districts from distant warehouses or warehouses that are not closest to the district. However, in order to be able to keep the promise of next day deliveries and to reduce unnecessary travel, *Haggis & Whiskey* imposes that the distance between a postal district and its serving warehouse may not exceed 150 miles and a penalty of £50,000 is applied each time a district is not supplied from the closest located warehouse.

One of *Haggis & Whiskey's* goals is, obviously, to minimize the total setup and transportation costs over the next 20 years. This, however, is not their only objective for designing the supply chain, but they struggle to put their other considerations into words. Can you come up with suggestions and include them in your modelling?

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