Mat-2.4177
Seminar on Case Studies in Operation Research
Forecasting the consumption of district heating
Interim report

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1 Project Status

1.1 Literature Review

A literature review has been conducted on district heating and the models to predict the heat demand. In addition to background information about the underlying process, this has given us information about the types of models to try, how to include the temperature in the models, and the methods used for model validation.

The models found in literature are fairly simple, so the review also included literature about newer approaches to time series modelling, which have not been directly applied to district heating before. These approaches, namely neural networks and Gaussian processes, will be excluded from our analysis as applying them would require more time and special knowledge, and it is not clear if we could expect better results than with simple models.

1.2 Models

ARMA model has been tried extensively. It was determined to be working but the calculations involved are computationally hard.

It was noted by Heller [1] that in literature the significance of the wind factor has been considered low compared to ambient temperature. At the time of writing, we do not have data on wind speed that could be used in the model.

2 Changes

The client expressed the desire for a light model. Static linear model achieved similar results as the ARMA model and therefore the static time series model will be treated as a viable alternative.

2.1 The model

A new way to model heat consumption was found. Static time series models with linear regression were mentioned in the literature. They was tested and we found it to be suitable for modelling heat consumption.

Earlier the objective was to use ARMA models to model the situation. Now the project and report are going to be about comparing these two approaches and reporting about their strengths and weaknesses. Finally a recommendation will be given on which model to use and how.

2.1.1 Groups

The data was grouped into five different groups as was originally planned. Linear regression with the groups and the effect of outliers were extensively tested. Using groups was deemed successful in the original data.

The building types in the test data given by Fortum were very different from the initial data used. Additionally, many of the buildings did not have a building type code in the metadata file. This may limit the analysis of data groups.

2.2 Test cases

We are expecting to get more data from Fortum. Originally we received data from 178 buildings from different areas in the network. This data was used to test whether our models were capable or not for forecasting.

The next step is to try to forecast the consumption for different neighbourhoods, other areas. Being able to forecast consumptions for different areas of the network is important in planning the production of heat.

3 Next steps

Different weightings of the data will be used to estimate static time series models to see if this will result in more accurate forecasts. Model validation will be conducted using methods found in literature. Ways to make use of the area data will be explored.

The test data from the client has been received. Due to deadlines in other courses in early April, we will test our models on this data in April.

An overview on the uncertainty of the weather forecasts will be conducted based on literature.

4 Schedule

20/3	Background ready.
End of March	Mid-report ready.
4/4	Presentation of the mid-report.
25/4	Forecast for the pre-specified areas in the network ready
1/5	Content of the project and report ready.
16/5	Presentation of the project.

5 Updated risks

New risks include problems with the new supplied test data.

Realized risks include the following. The house types metadata in the area test data and the original data contained few similar building types, which means that the group forecasting does not work out-of-the-box. Separation into groups requires additional time and work.

Risks that have not realized include problems with literature or methods. Enough information about forecasting heat consumption and methods were found. The usage of time has been successful, too. Members of the group that have completed their tasks have been assigned new tasks keeping the individual loads in mind. Failure in management seems unlikely at this point of the project.

References

[1] AJ Heller. Heat-load modelling for large systems. *Applied Energy*, 72(1):371–387, 2002. Elsevier.