

# Course 02418

## Statistical modelling: Theory and practice

Case: Energy consumption

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# Estimating heat loss from energy consumption

- Today houses get a energy label based on a consultant entering information on insulation, construction type, area and type of windows etc into a model. This is subjective and expensive.
- Logging energy consumption could be an alternative
- when combined with local climate data.
- Modelling can be done on many timescales here daily averages are used.

# Parameters of interest

- UA Response from temperature differences [ $\text{W}/\text{degC}$ ]  
This depends on degree of insulation.
- gA Response from sun radiation [ $\text{W}/\text{lux}$ ]  
This depends on location, size, and type of windows
- wA Response from wind speed [ $\text{W}/(\text{m/s})$ ]  
This depends on how airtight the house is.

- Heat loss,  $Q$ , across a wall:

$$Q = U_a(T_a - T_i)$$

where  $U_a$  is what we want and  $T_a$  and  $T_i$  are ambient and indoor temperatures.

- Houses may have windows facing the sun. So there may be a dependence on the (global) radiation,  $G$ .
- Wind both reduces the exterior boundary effect and may increase the air change if the house is not sealed properly.

# The data

All observations are daily averages.

Variable	Min	Max	Unit	Description
t			[days]	Date
houseId				Integer indicator of house
Q	0.00	7.86	[kW]	Heat consumption
Ta	-8.47	25.12	[degC]	Ambient temperature
Ws	0.02	7.73	[m/s]	Windspeed
G	3.61	382.95	[W/m <sup>2</sup> ]	Radiation from sun on horizontal surface
sunElev	0.13	0.57	[rad]	Angle of sun when above horizon

It should be noted that some observations are missing.

# What to do

The main focus is on estimating UA and wA for the houses.

- EDA
- Pick data from one house
  - Fit a good linear model without interactions.
  - Fit a good linear model with interactions.
  - Comment on the results. Does the model make physical sense?
  - Should part of the data be left out?
  - Fit a good linear model that makes physical sense.
- Fit a good model that makes physical sense using all houses
- Should some houses be left out?
- Comment on the results. How does the houses differ?
- Would you obtain (almost) the same results if fitting a model per house?

# Heat consumption data [kW] for all 16 houses

