Analysis of high frequency smart meter data

PhD study plan presentation, 23/10/15

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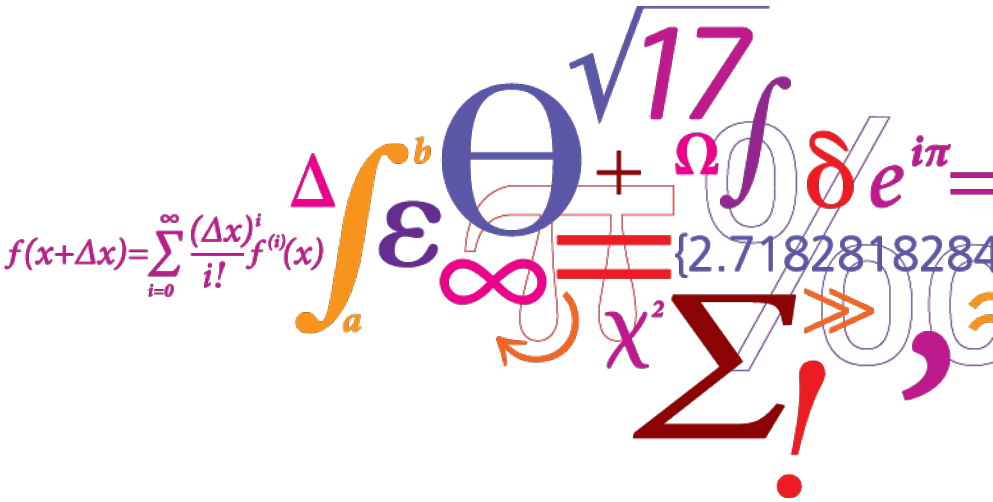

DTU Management Engineering
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ToC

- A little bit about myself
- A brief overview of the CITIES project and where my projcet fits in.
- Research questions
- Methods and theory
- Deliverables
- Planned courses
- Questions

About me...

- Born 1982 in Århus, DK, makes me 33 years old!
  - Danish mom, Austrian dad with old family ties to the Czech republic, hence the surname.

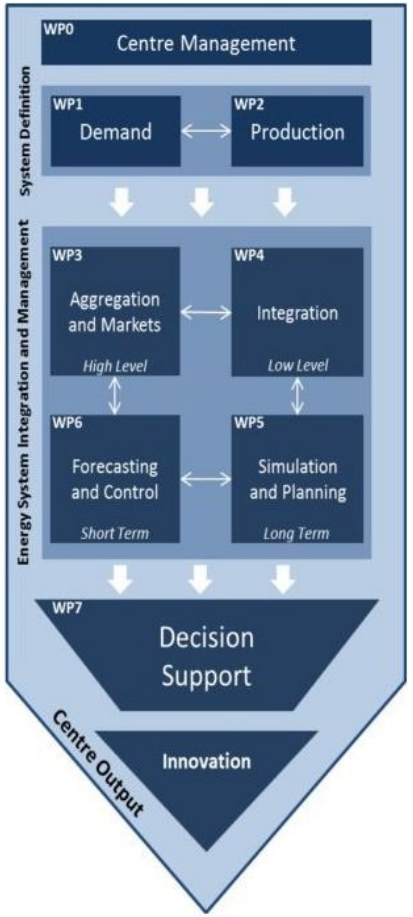
- Graduated from IMM DTU 2009 (Compute today) as Civil ingeniør (M.Sc. Applied math) with emphasis on statistics and machine learning.

- Worked 5 years with statistical classification as marketing and risk analyst in various places like finance and government.

- Professional Interests: Statistical classification and programming, especially the Python programming language has my attention. Persondataloven and it's implications.

The CITIES project

- **C**entre for **IT**–**I**ntelligent **E**nergy **S**ystem in Cities, is focused on:
  - establishing an integrated research centre covering all aspects of the energy system using IT in the system from production to consumption.
  - Lots of partners (public and private)
  - Visit our site: smart-cities-centre.org or even better sign up to follow our Twitter on the website.
  - 7 WP's
  - WP1: Demand side analysis and data collection / data hub



WP1 - Demand side analysis

- WP 1 is focused on the inhabitants in the buildings and the way they consume energy.
- All energy consumption is interesting, but limited to smart meter data.
- We are NOT looking at the dynamics of buildings but mainly focused on active consumption.
- We are interested in how external data, socio-economic and other types can be included.

Research Questions:

1. What is the current state-of-the-art in smart meter analysis?

2. What statistical learning algorithms perform well in classifying energy consumers. And how does the classification compare to socio-economic classification?

3. How can smart meter data be used to characterize household consumption?

4. Can smart meter data be used to decompose the consumption into active (habitant) and passive (building) consumption. And can it be used to estimate energy flexibility?

My initial focus will be district heating end users.

Classification of energy consumers

- Statistical learning methods:
    - Supervised (X -> Y mapping)
        - NN / Deep Learning / SVM
    - Unsupervised (Unknown mapping)
        - KNN
        - Cluster analysis

- External data
    - For comparison of classification
    - Refinement of classification

- Paper working title:

  Statistical classification of consumers in district heating system using smart meter data.

Characterization of consumption

- Time series analysis
    - Possible Non-linear models
    - Hidden Markov models
    - Time series for high frequency data / change in variance structure

- Statistical quality control
    - Shift detection to identifying change in consumption.

- Paper working titles:

  Using smart meter data to investigate the correlation between power and heating consumption in households

  Using smart meter data to characterize energy consumption households

Decomposition and flexibility

- Identify active and passive consumption
  - Flexibility
  - Energy savings

- This will build heavily on the identified classes and consumption characteristics.

Paper working title:

Decomposing household energy consumption attributable to habitants and buildings and investigate flexibility using smart meter data.

Deliverables

- 4 journal papers!

- Program that can classify consumers and characterize consumption for each group.

Planned courses

- 02433 Hidden Markov Models
- 02282 Algorithms for massive dataset
- 02170 Database systems
- 42702 Research and PhD-studies at DTU MAN

- PhD class in Deep learning KU
- Advanced methods in statistical data analysis KU

- Still 5 points left for statistics or high performance computing.

Questions...?