Forecasting as business case

Florian Unger
February 2019

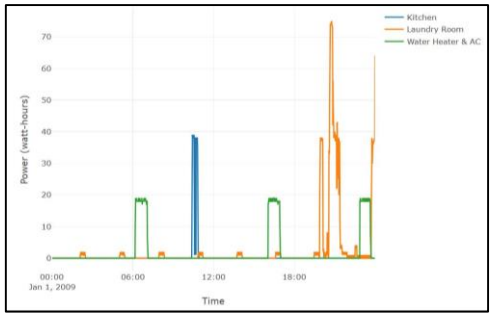
Agenda

- What does the customer want?
  - Various Business cases
- How did we get here?
  - N/As
  - Model Choice
- Business recommendations

What does the customer want?

Understanding

- Which appliances are used, for how long and when? ✓
- Timing recommendations? ✗



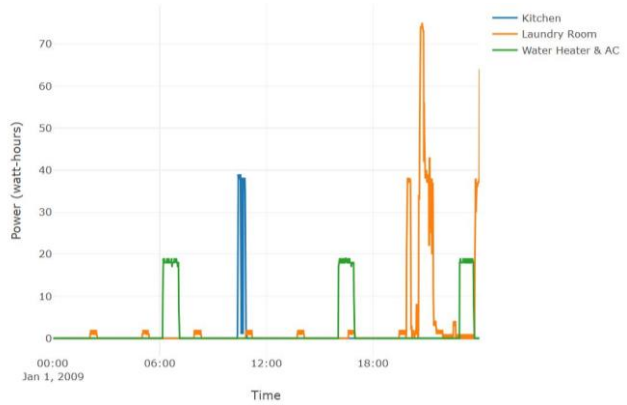
Forecast

- Forecast appliance usage? ✗
- Forecast total spending? ✓

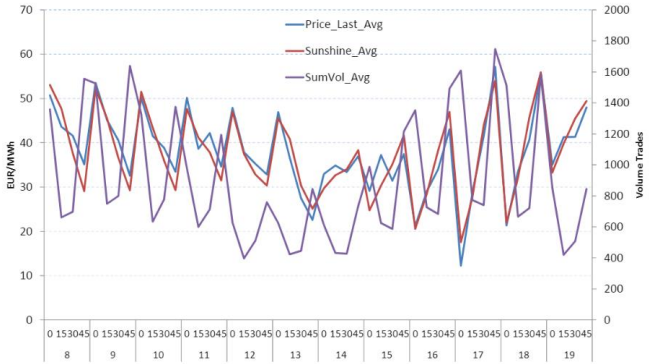
Date	EUR
4.1.2010	31,4
11.1.2010	32,6
18.1.2010	32,1
25.12.2010	33,8
1.1.2011	32,6

Business Case I: Timing recommendations

Power consumption



Intraday Price changes



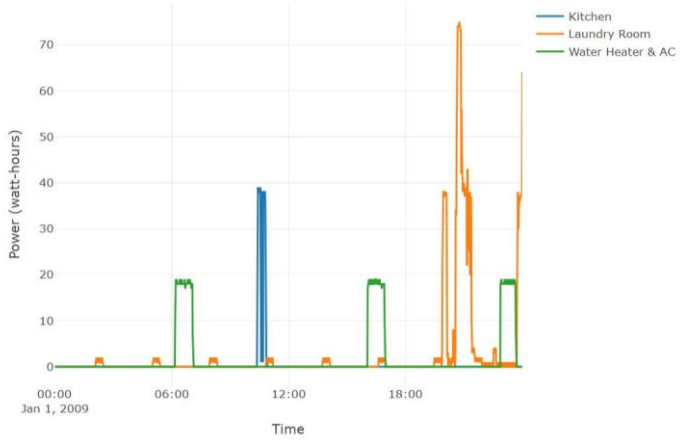
\+ 3c savings by doing laundry at 4:30am

\- Neighbors will complain
Electricity comes from coal
Really inconvenient

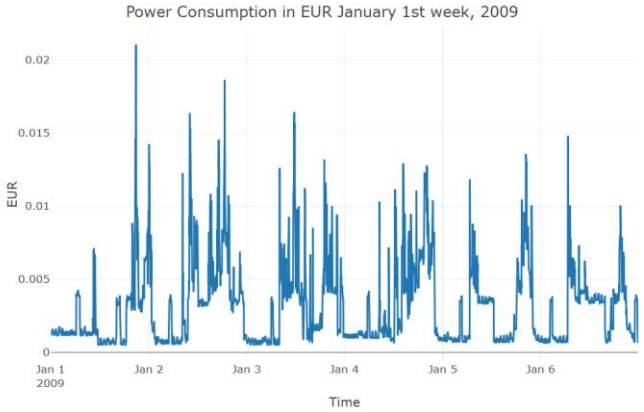
Timing recommendations are NOT a sustainable business case

Business Case II: Stats and F-Facts

Power consumption by appliance



Consumption in EUR

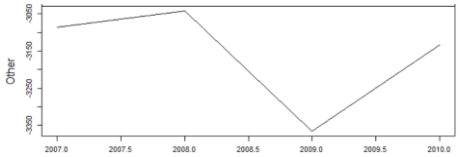
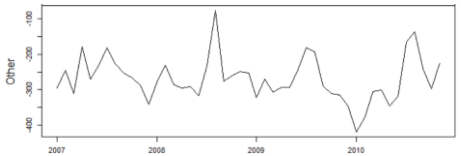
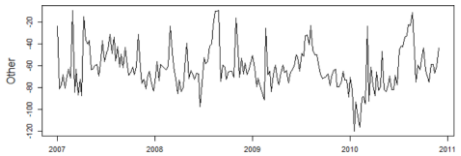
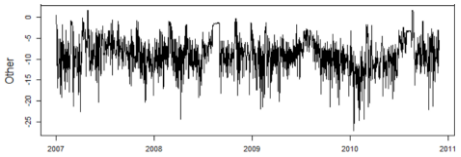


+

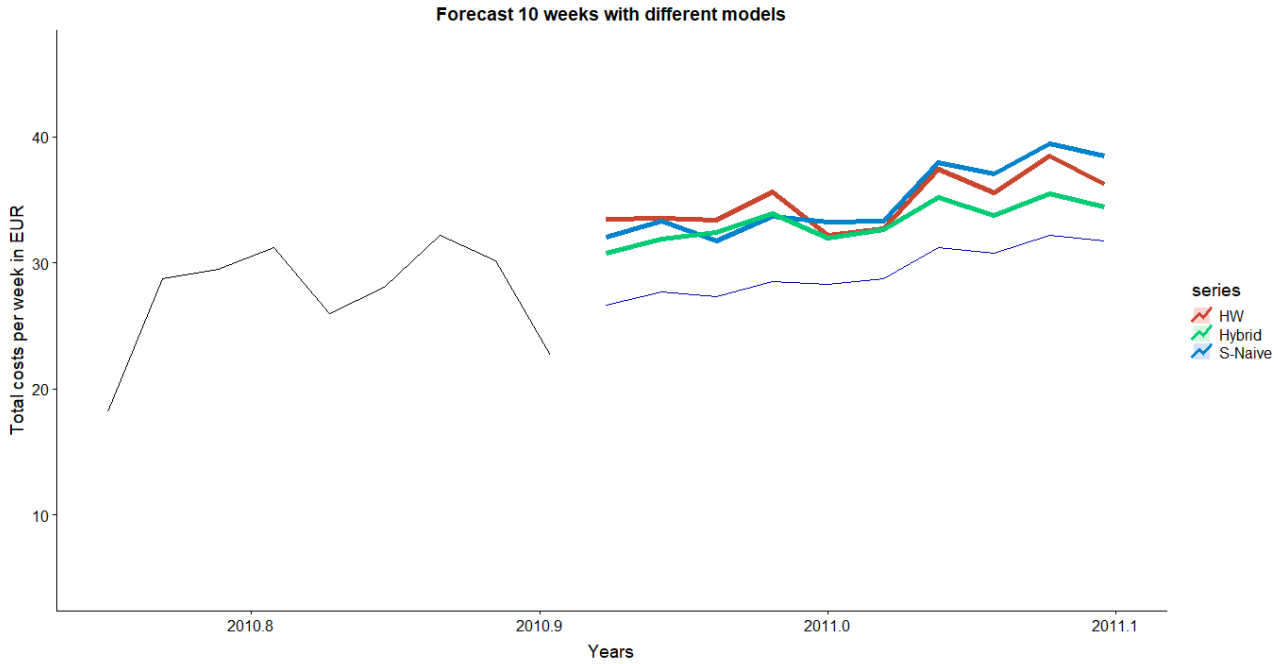
Adding understanding to the customer

Inform rather than recommend

Business_Case III: Forecasting

Granularity		User case	Stat. Predictability
Year		✗	✗
Month		✗	✓
Week		✓	✓
Day		✓	✗

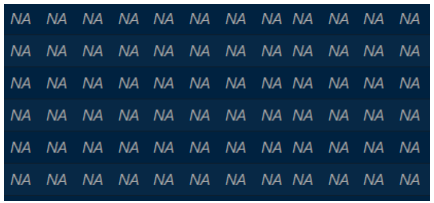
Forecasting_for_the_next_10_weeks



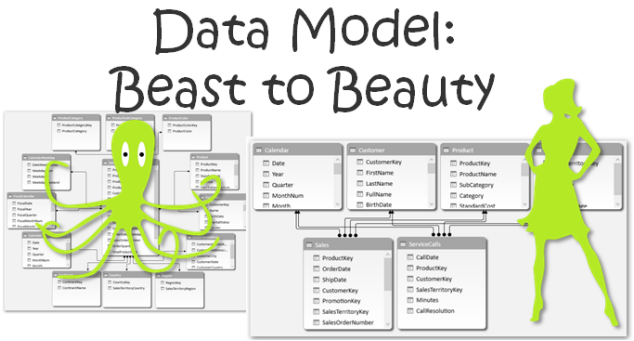
Date	EUR
4.1.2010	31,4
11.1.2010	32,6
18.1.2010	32,1
25.12.2010	33,8
1.1.2011	32,6
8.1.2011	33,0
15.1.2011	36,5
22.1.2011	35,4
29.1.2011	37,4
5.2.2011	36,5

How did we get here?

NAs



Model choice



NAs_by_Year

WHY are they here?

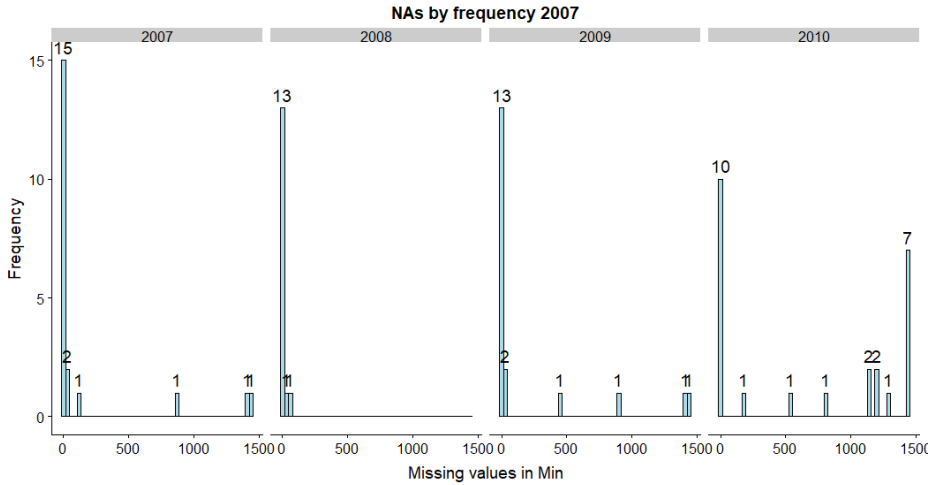
- <1000 min: Power outages, SM errors
- >1000 min: Holidays, Power outages

WHY do we treat them?

- Distort our data and the trend
- Improve forecasting ability

HOW do we treat them?

- Plain Vanilla: mean, last forward
- Computational: kalman



Test.Hybrid: MAE

Methodology I:	**Last one forward for 'todos'**	**3.18 €**
Methodology II:	**Last one forward < 1000min + na.kalman**	**2.97 €**

- 6.6%

Decide on Forecasting models (I/II)

Why is model choice important?

- Right model helps us to forecast more accurately, taking into account TREND, NOISE and SEASONALITY
- Accurate forecast -> higher customer satisfaction -> lower churn -> increasing profitability

Which models are available?

Naive

? Equal to the last observation

\- Too simple

\+ Works well for unpredictable behavior

S-Naive

? Last observation of previous season

\- Fails to account for big trend changes

\+ Useful for data with strong seasonality

Arima

? does not assume knowledge of underlying model

\- Relies to much on past values

\+ Robust in short-run forecasting

Holt-Winters

? finding the central value, then adding in the effects of slope and seasonality

\- More weighting to recent values

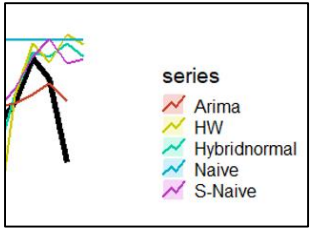
\+ Easy to apply and to understand

Decide on Forecasting models (II/II)

How to decide on the models?

1 Graphical representation

- ? Split time series into training and test set
- ? Plot the models on the test set and compare with real values



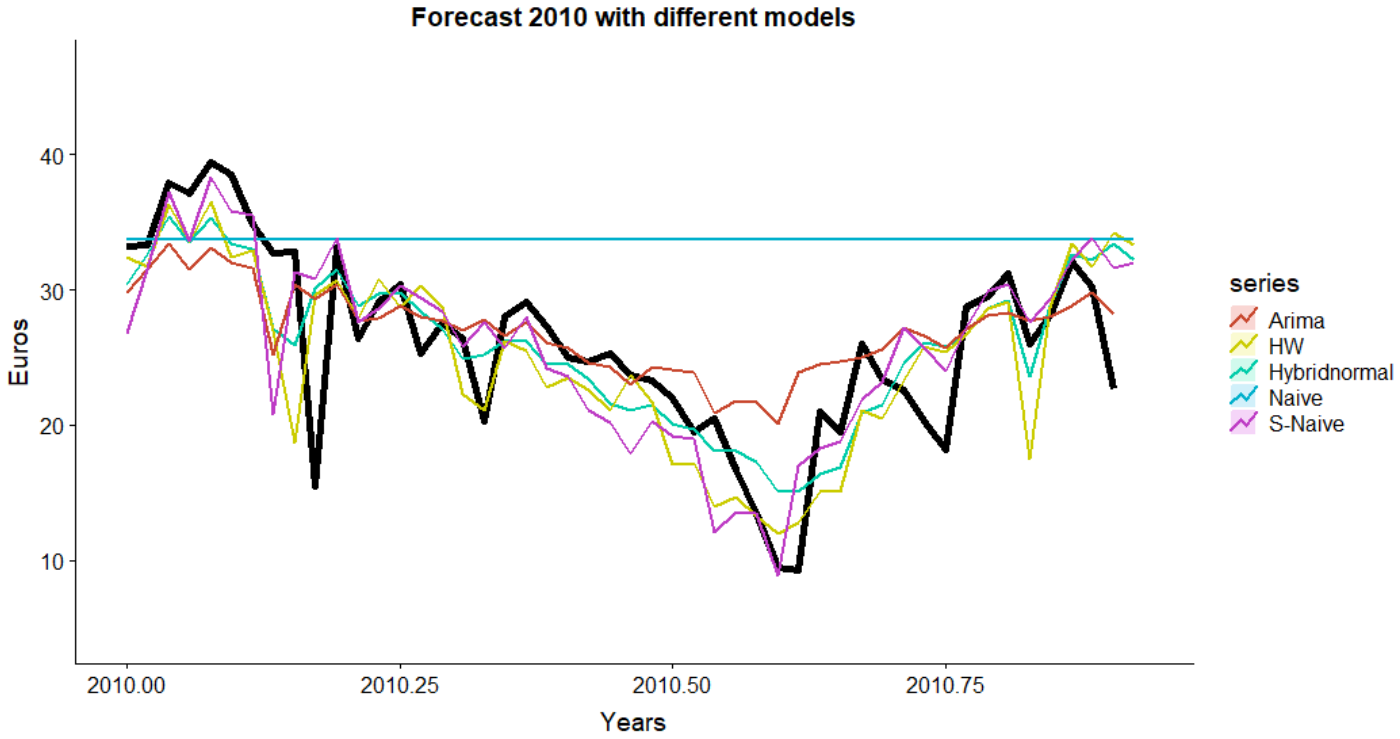
2 Accuracy

- ? Mean Absolute Error: average magnitude of errors, more appropriate for absolute values
- ? RMSE: large weighting to large errors
- ! Need to look into errors individually

3 Autocorrelation Function and ND plot

- ? ND plot: shows if the errors are normally distributed, otherwise trend would be still in errors
- ? ACF plot: are the errors also uuncorrelated below the threshold? They should be.

1 Train on 2007 – 2009 & Test on 2010



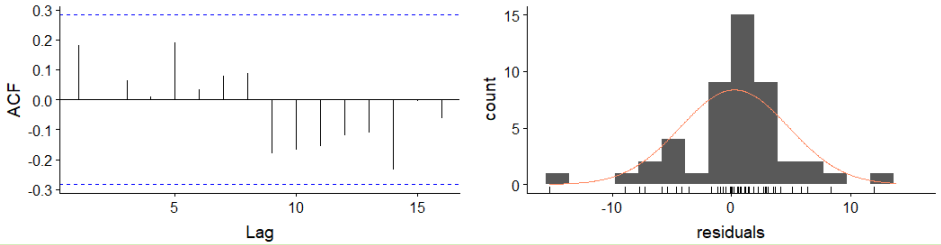
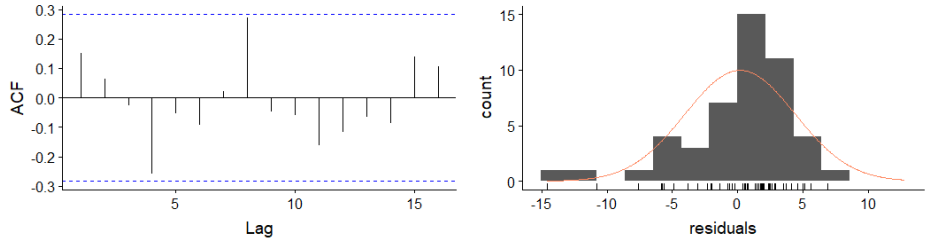
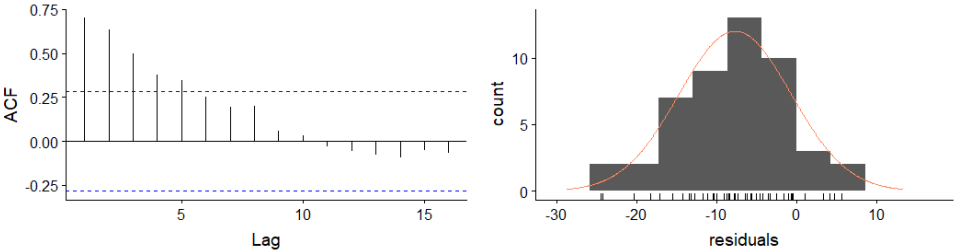
- **Hybrid > S-Naive** > HW > Arima > Naive

2 Accuracy plots

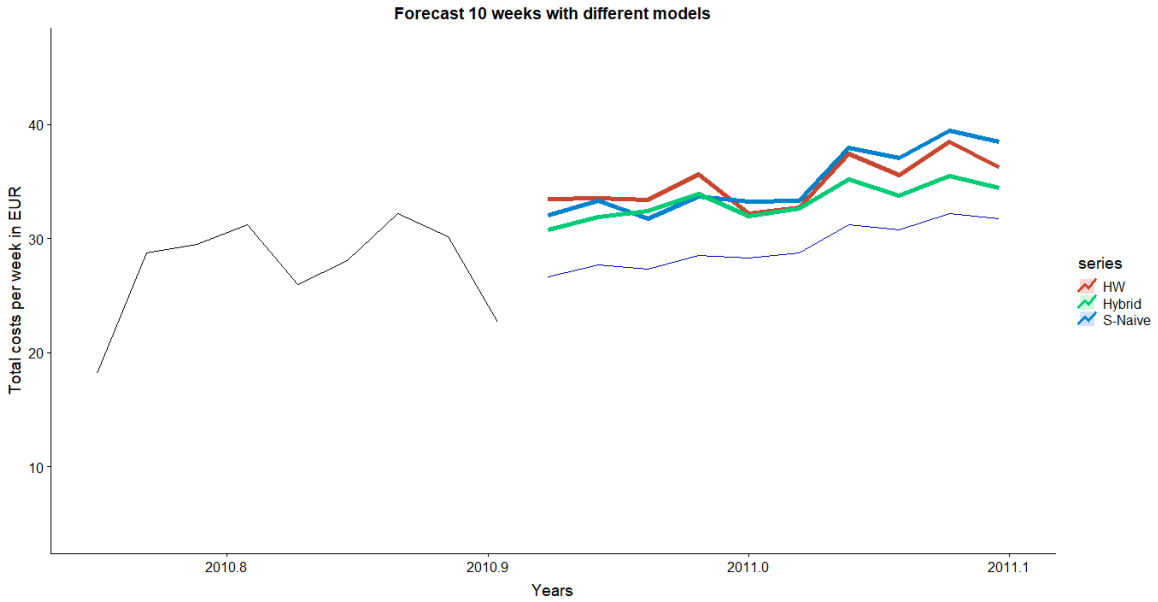
		ME	RMSE	MAE	MAE*		Reason
ARIMA	Training	-0,05	4,95	3,52	3,54	✗	Score
	Test	-0,83	5,03	3,66	3,61		
HW	Training	-0,43	4,75	3,05	3,10	✗	Score
	Test	1,04	4,62	3,40	3,59		
Naive	Training	0,02	6,19	3,91	3,90	✗	Overfitting
	Test	-7,36	10,13	8,19	8,46		
SNaive	Training	-0,44	6,09	4,32	4,38	✓	
	Test	0,40	4,43	3,01	3,16		
Hybrid	Training	-0,26	3,67	2,66	2,69	✓	
	Test	0,34	4,00	2,97	3,18		

* locf-treatment

3 Residual_plots: AFC

		ACF	ND
S-Naive		✓	✓
Hybrid		✓	✓
Naive		✗	✓

Forecasting_for_the_next_10_weeks



Date	EUR
4.12.2010	31,4
11.12.2010	32,6
18.12.2010	32,1
25.12.2010	33,8
1.1.2011	32,6
8.1.2011	33,0
15.1.2011	36,5
22.1.2011	35,4
29.1.2011	37,4
5.2.2011	36,5

Recommendations

- **Understand Granularity**
  - Not all applications make sense from business and technical perspective
- **Understand models**
  - Use different models for different use cases
- **Understand NAs**
  - Different NA treatment impacts accuracy

THANK YOU FOR YOUR ATTENTION

QUESTIONS?