Electricity price forecasting using Markov regime switching model

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Overview

1. Introduction
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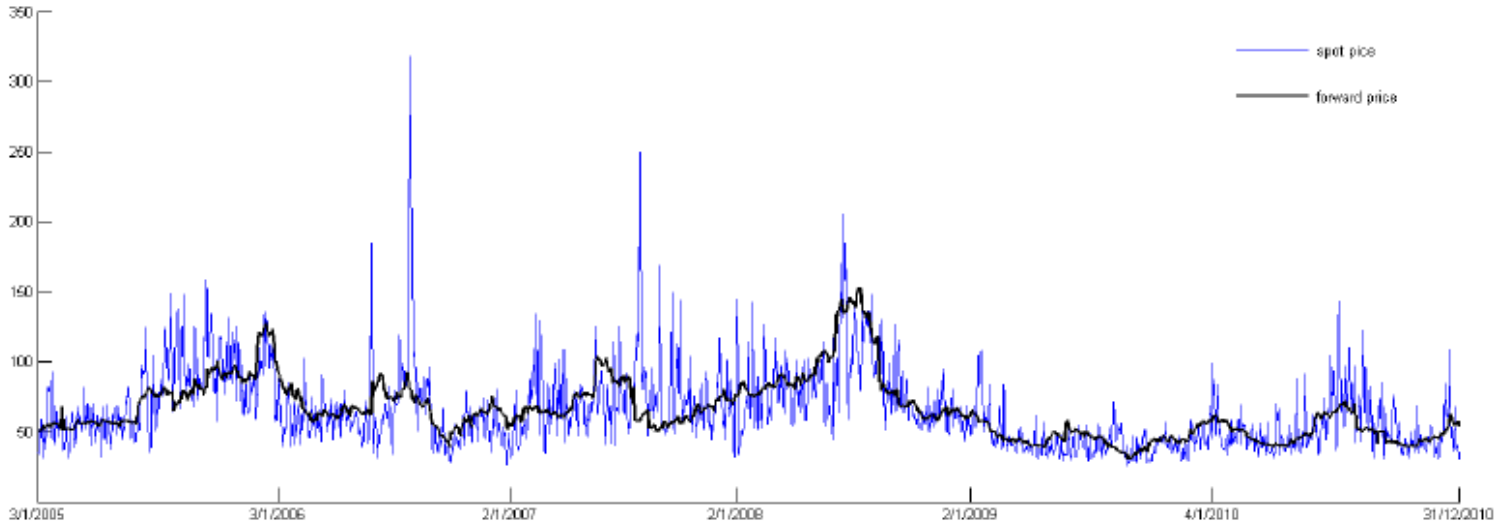
3. Deseasonalizing
4. Markov switching model
5. EM Algorithm
6. Simulation
7. Measuring performance

Electricity price forecasting using Markov regime switching model

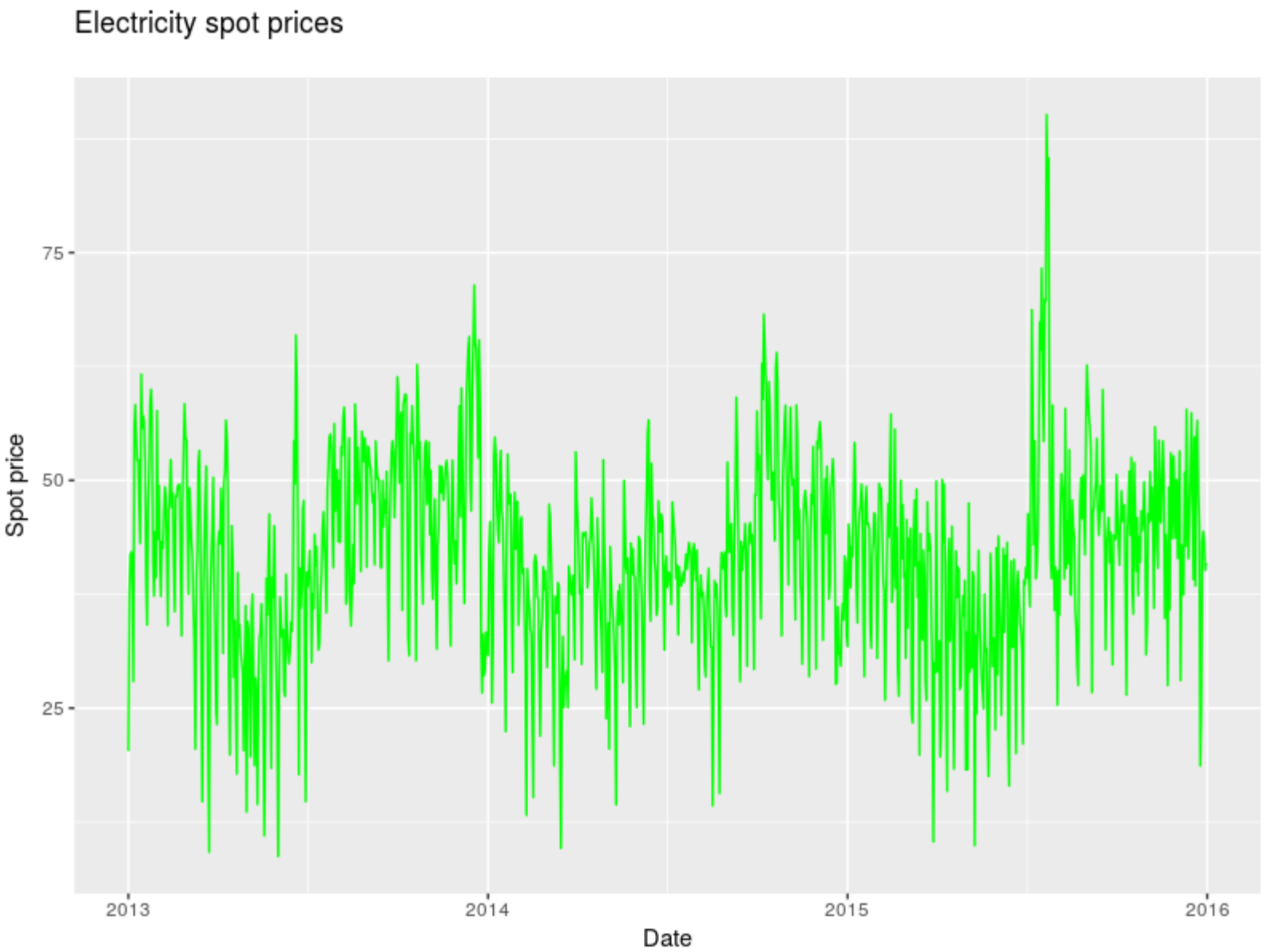
- Take publicly available data on electricity prices
- Pre-process it (deseasonalize, average, split to train and test)
- Choose an appropriate regime switching model
- Fit the model using EM algorithm
- Run a simulation and try to predict test data
- Measure performance

Electricity price data

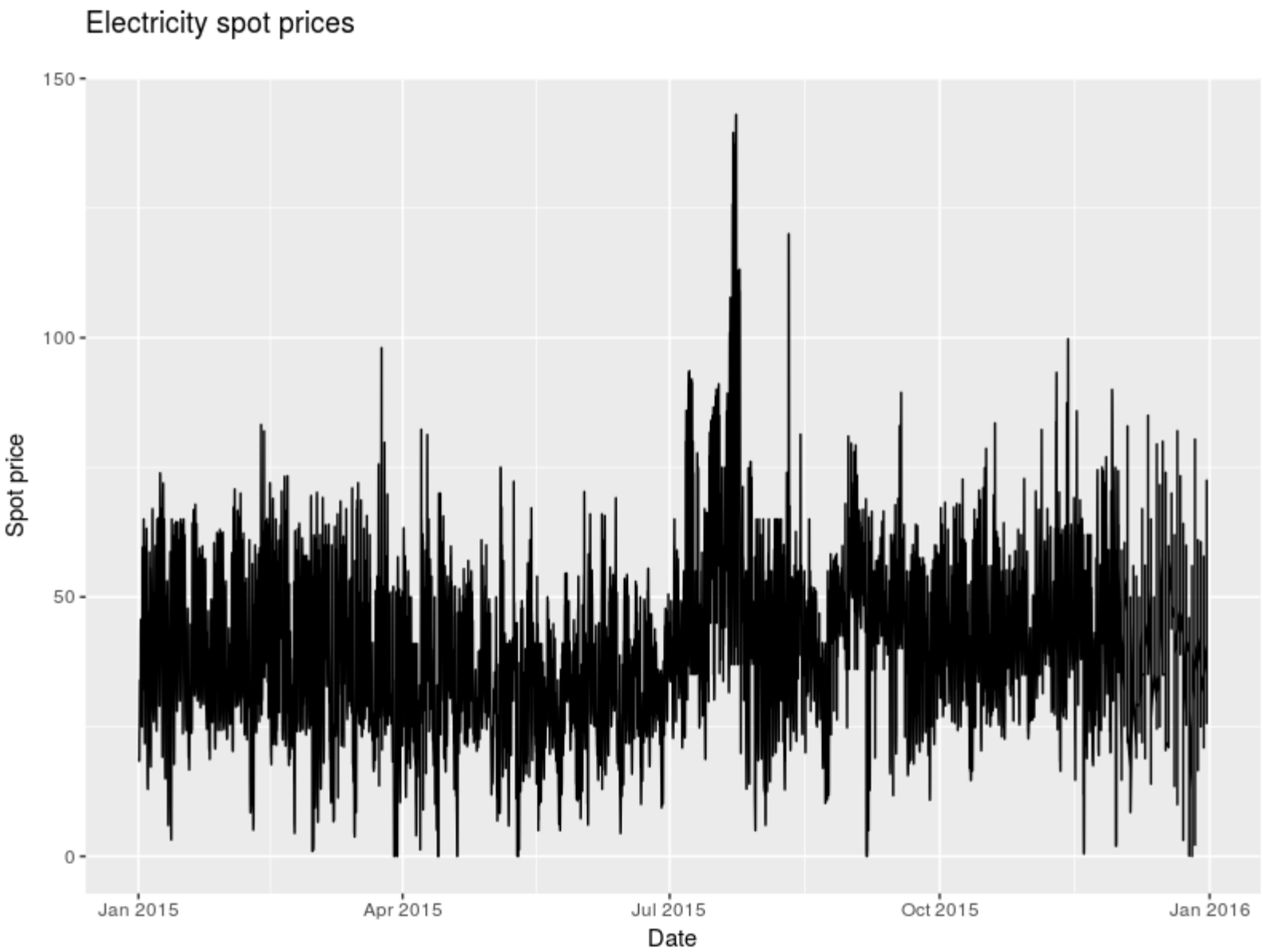
- The data is publicly available
- Is influenced by seasons, has a weekly trend
- Deseasonalizing needed
- Exhibits random periods when prices spike



Electricity price data



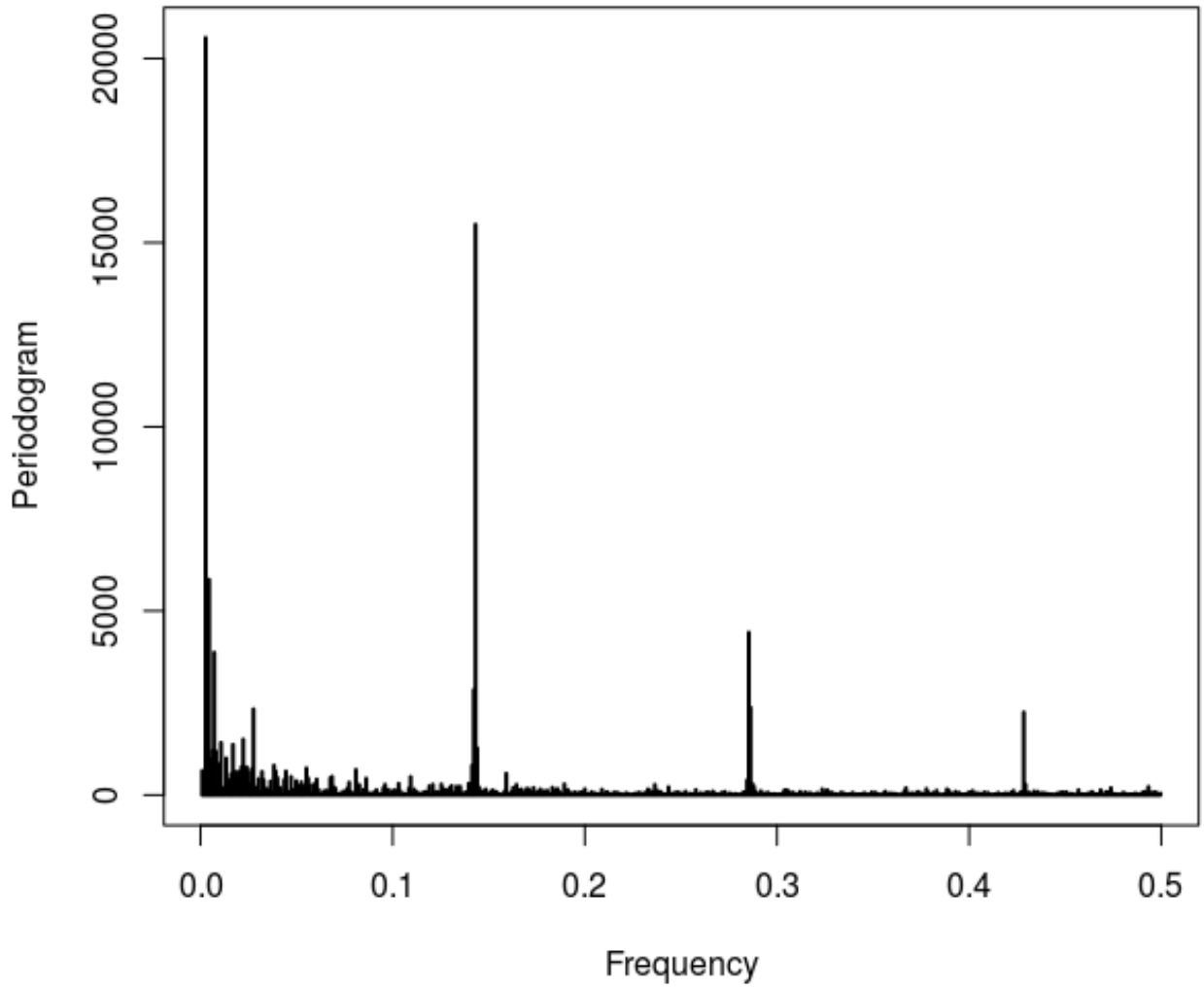
Electricity price data



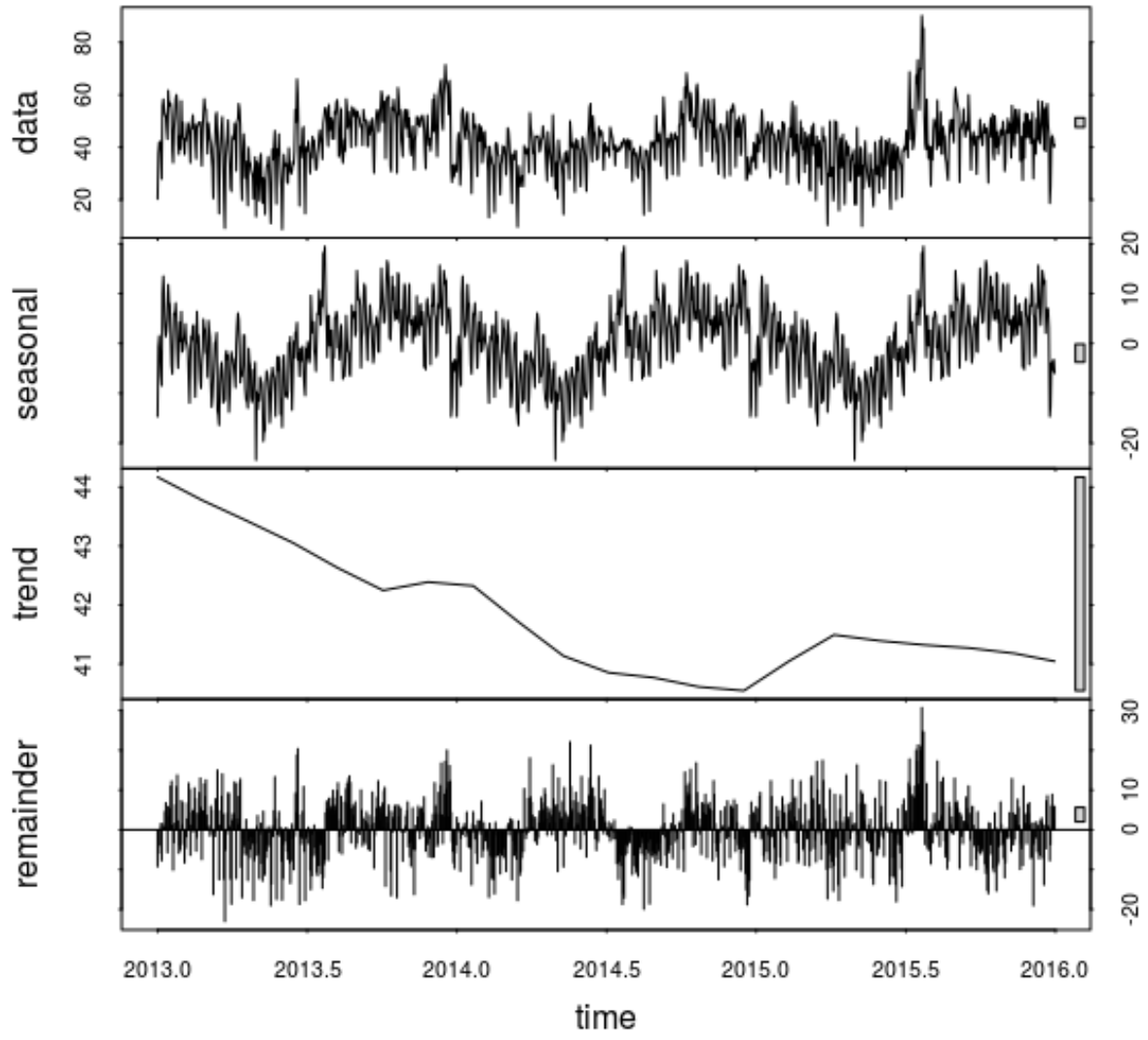
Deseasonalizing

- The focus in a different project
- I used a preexisting STL function in R
- It detects trend and seasons in your time series data
- After subtracting trend and seasons you are left with the stochastic part of your process

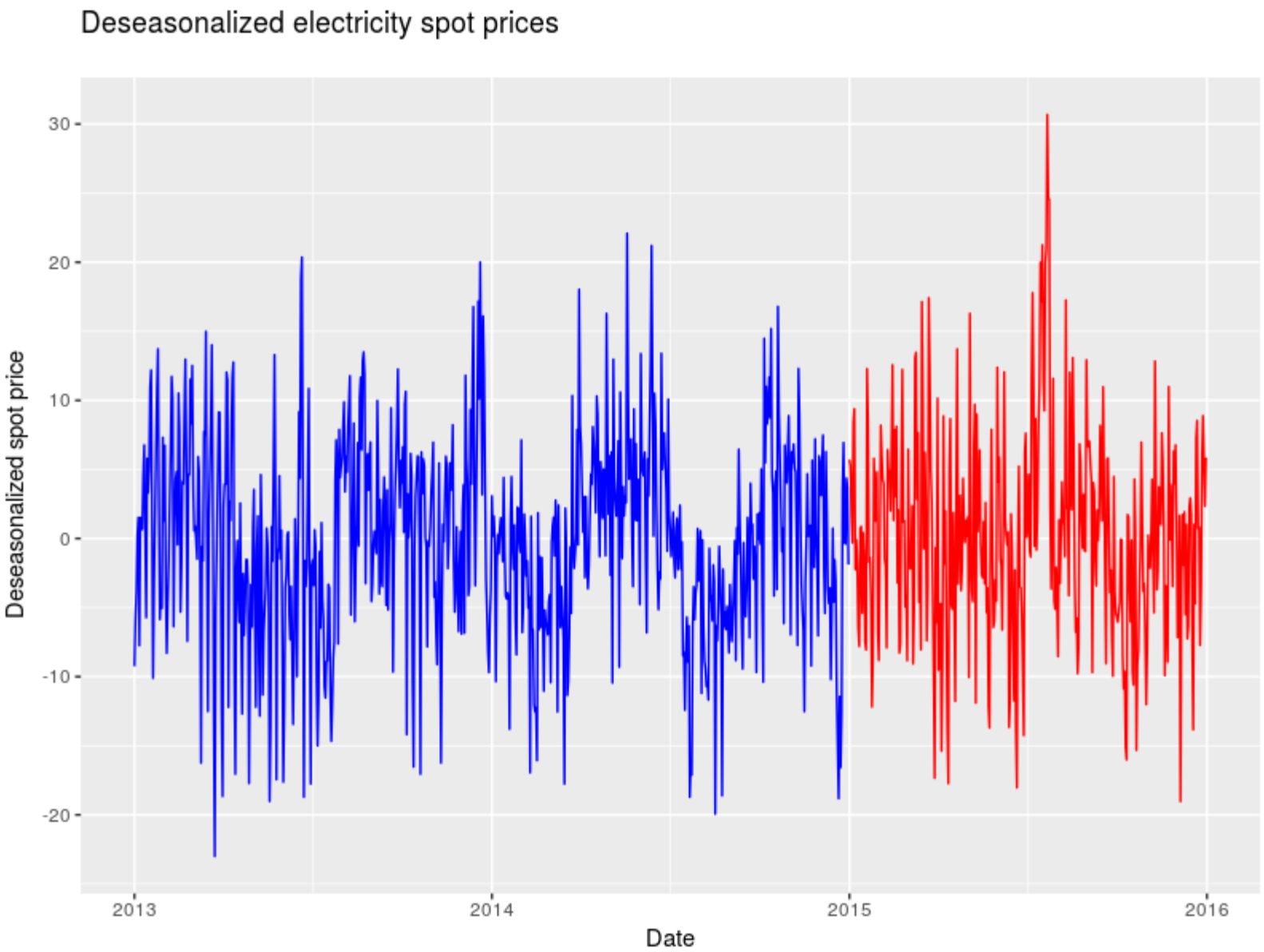
Deseasonalizing



Deseasonalizing



Deseasonalizing



Markov switching model

- What is a Markov switching model?
- Motivation for using it in electricity prices modeling
- Our data does not show clear signs of base an spike regimes
- We can still use it
- How do we use it?
- How do we fit it to the data?

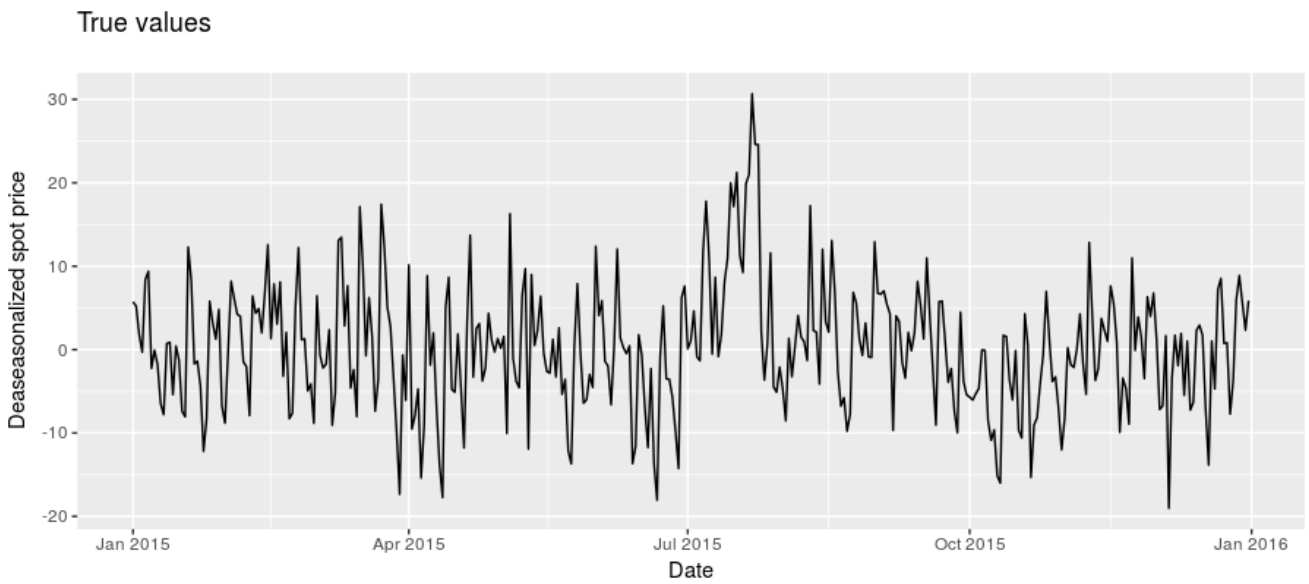
EM Algorithm

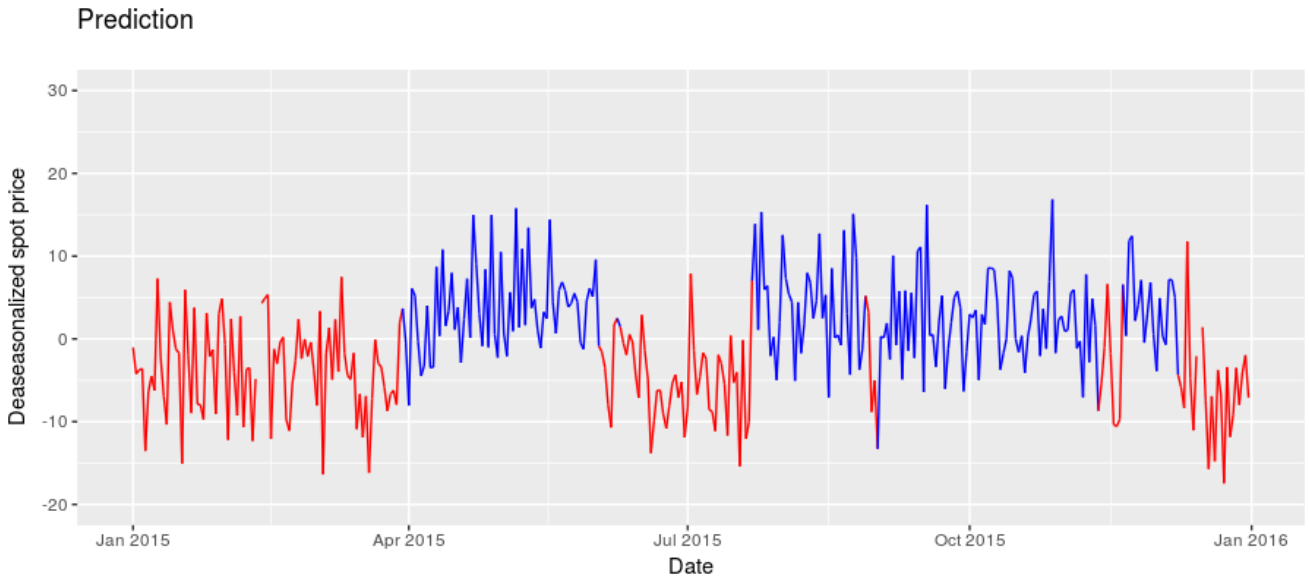
- What kind of Markov switching model was used.
- What parameters did I have to fit.
- EM Algorithm is iterative and gradually improves parameters using likelihood
- Implementing this was by far the most difficult part of the project
- Managed to do it by following an example from Erik Kole
- It converged nicely and fitted the parameters on my data

The final parameters:

- $\mu_0 = 3.21, \sigma_0 = 6.20$
- $\mu_1 = -5.16, \sigma_1 = 5.59$
- $p_{00} = 0.97, p_{11} = 0.96$
- $\xi \approx 0$

Simulation


True values
Deaseasonalized spot price
30
20
10
0
-10
-20
Jan 2015
Apr 2015
Jul 2015
Oct 2015
Jan 2016
Date


Prediction
Deaseasonalized spot price
30
20
10
0
-10
-20
Jan 2015
Apr 2015
Jul 2015
Oct 2015
Jan 2016
Date

Measuring performance

- 20 simulations:
- RMSE: $\mu = 10.32, \sigma = 0.44$
- MAPE: $\mu = 29, \sigma = 1.22$
- 1000 simulations:
- RMSE: $\mu = 10.36, \sigma = 0.43$
- MAPE: $\mu = 29.39, \sigma = 1.21$
- 10000 simulations:
- RMSE: $\mu = 10.36, \sigma = 0.43$
- MAPE: $\mu = 29.35, \sigma = 1.27$

References


Bierbrauer, Michael, Stefan Trück, and Rafa Weron.
Modeling electricity prices with regime switching models.
Computational Science-ICCS 2004 (2004)


http://prac.im.pwr.wroc.pl/~hugo/publ/BierbrauerTrueckRWeron04_ICCS.pdf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https://anomaly.io/seasonal-trend-decomposition-in-r/


https://anomaly.io/detect-seasonality-using-fourier-transform-r/

The End