



# The uncertain electricity price

Prediction with Uncertainty, Dec 6 2022

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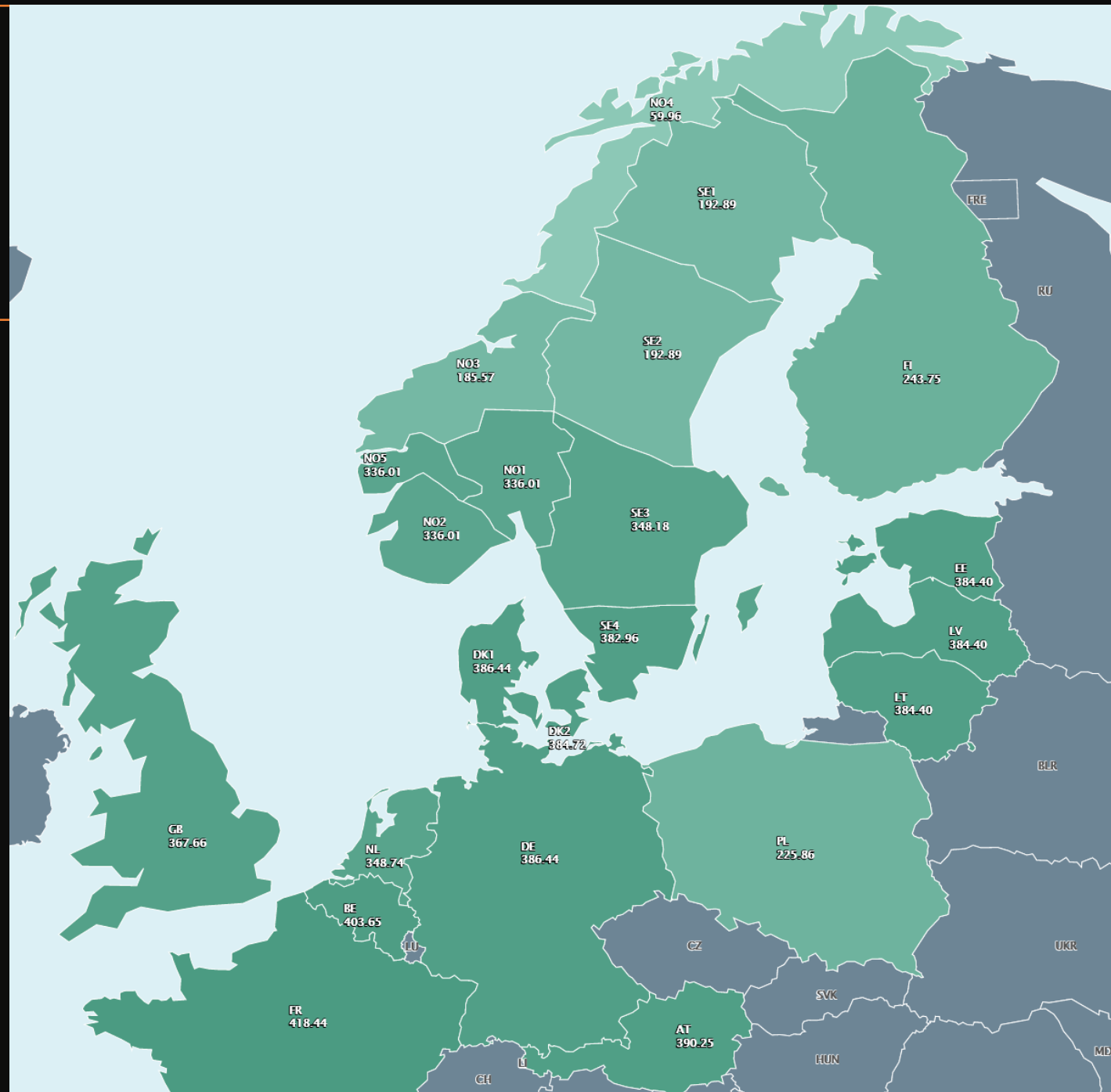
# Why is it important to know the electricity price?



# Nordpool

Exchange market for physical electricity in 16 European countries

Sets the day-ahead spot price per area



# Financial electricity compensation in Norway (strømstøtte)



$$(\text{Mean monthly spot price} - 0.70) \times 0.90 \times 1.25 = \text{compensation}$$

NOK/kWh ex. tax  
(settled at Nordpool)

Compensation  
threshold

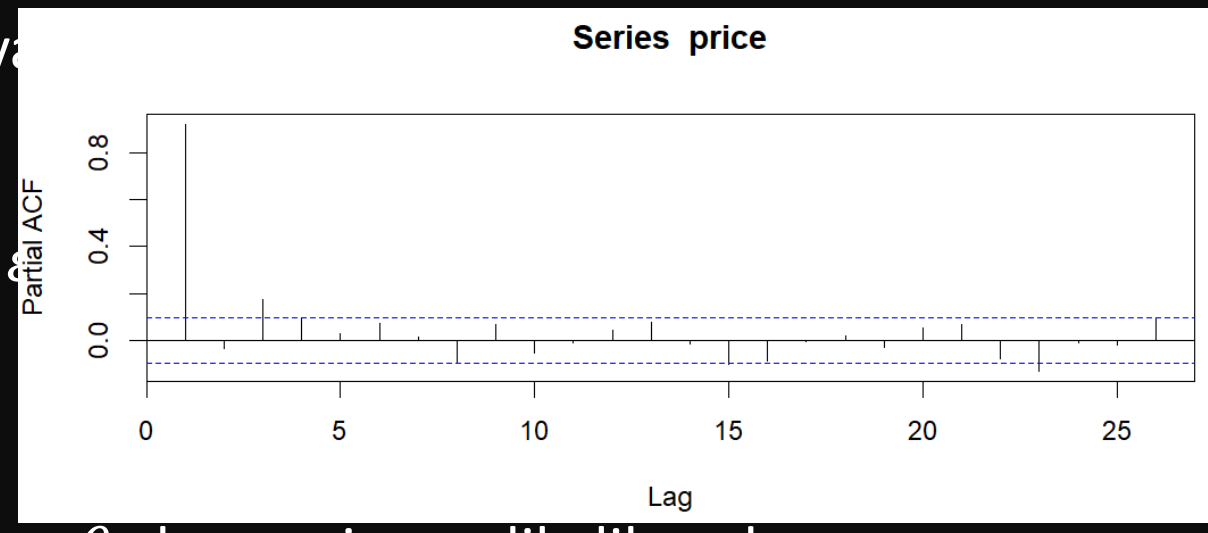
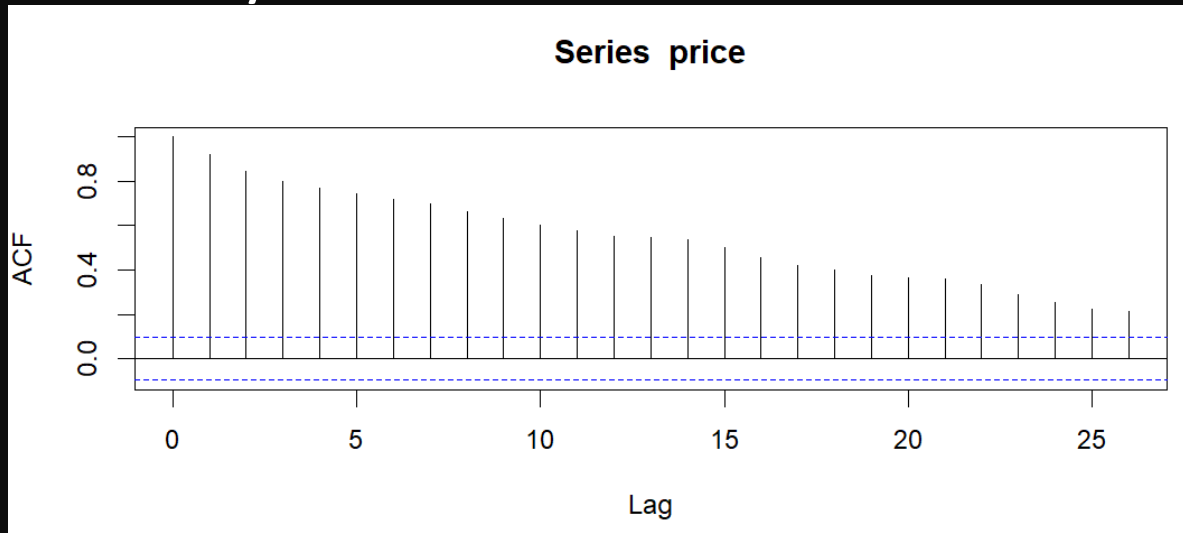
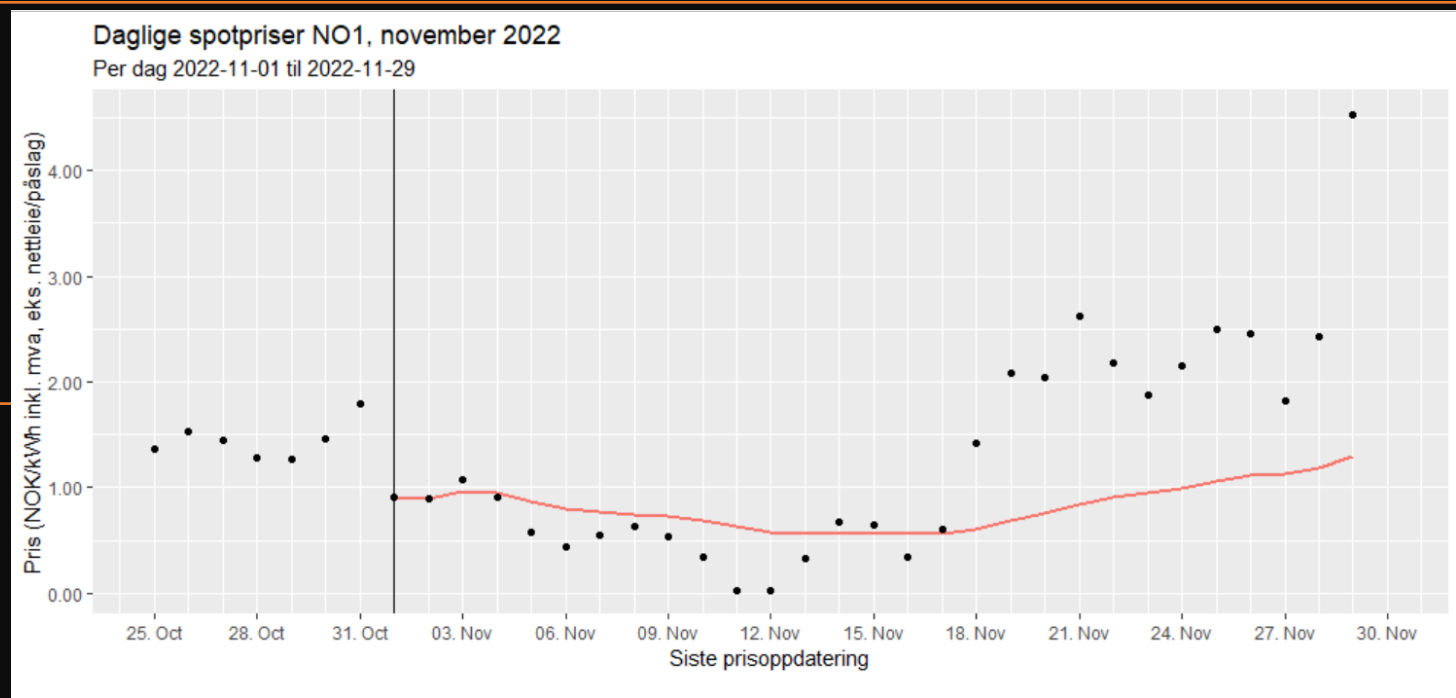
Compensation  
factor

25% tax

NOK per  
consumed kWh

# Modelling the daily spotprice

- Clear time dependence and weekend effect
- My basic model:



- Fitting parameters  $\beta, c, \phi_1, \dots, \phi_p, \theta_1, \dots, \theta_q$  by maximum likelihood
- Selecting orders  $p, q, d$  by AIC grid-search

# Practical modelling of the compensation

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- Data: Daily historic spot prices [Nov21-Aug22]
- *One* model per price area
  - Error term is ARIMA(0,1,2) with drift for NO1, NO2, NO5
  - Error term is ARIMA(0,1,0) without drift for NO3, NO4
- Simulate  $k$  steps ahead with  $k = \text{\#remaining days in month}$ ,  $s = 10\ 000$  times
  - For each sample  $s$  : Compute monthly spot price -> Treat as sample from distribution of monthly spot prices
- Transform to distribution for compensation through formula
- Model weaknesses:
  - Does not account for weather or prices in futures market
  - No seasonality effects
  - No adaptiveness (model not refitted – yet)

# Model for NO1

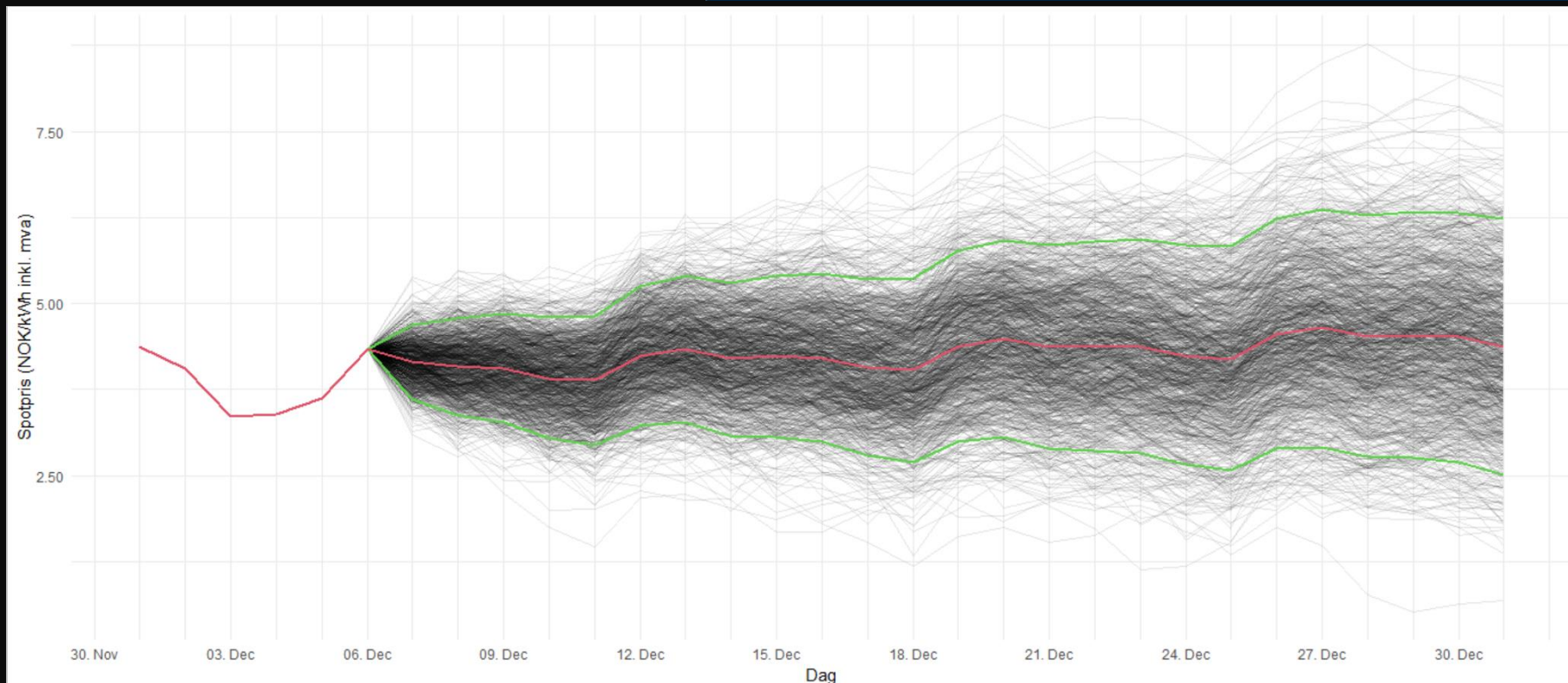
Series: this\_model\_training\_dt\$price  
Regression with ARIMA(0,1,2) errors

Coefficients:

	ma1	ma2	drift	wdayMon	wdayTue	wdayWed
	-0.1739	-0.1576	0.0212	0.3379	0.4060	0.2642
s.e.	0.0560	0.0543	0.0125	0.0494	0.0618	0.0643
	wdayThu	wdayFri	wdaySat			
	0.2618	0.2189	0.0619			
s.e.	0.0645	0.0620	0.0494			

$\sigma^2 = 0.1094$ : log likelihood = -90.14  
AIC=200.29 AICc=201.04 BIC=237.42

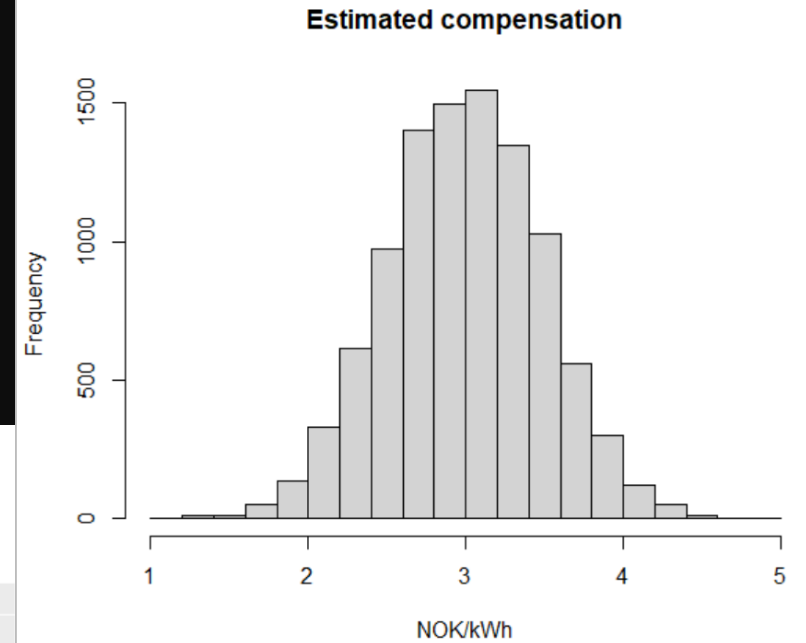
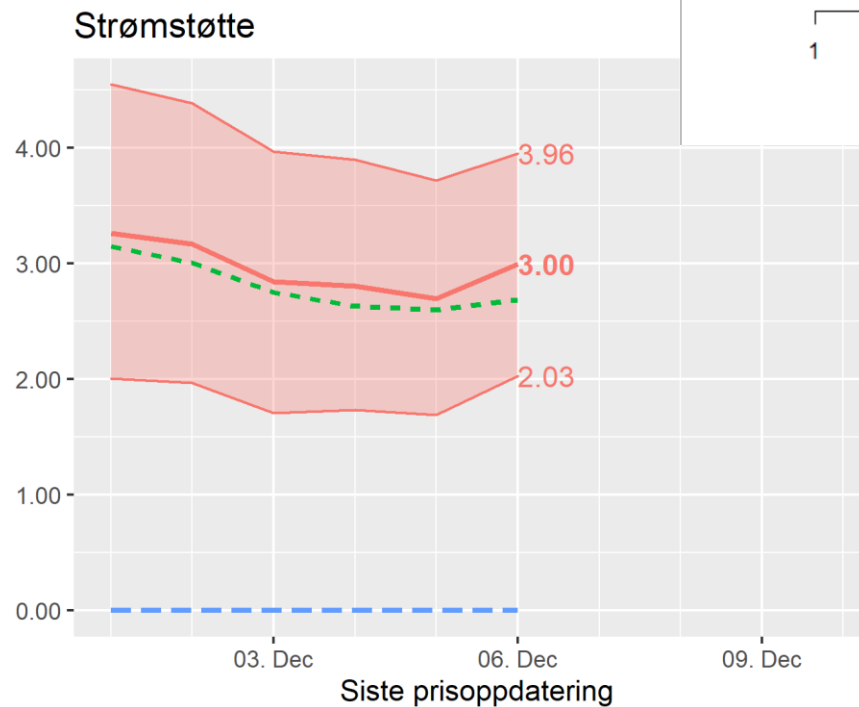
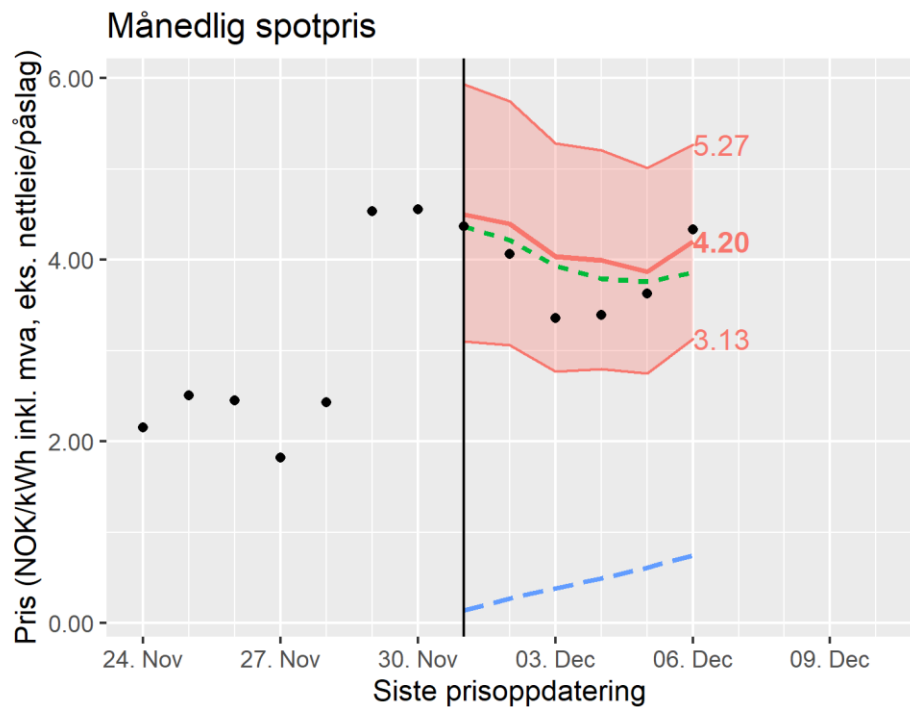
Simulated future spot prices NO1



# Model for NO1

Estimert månedlig spotpris og strømstøtte for prisområde NO1 (Østlandet) desember 2022

Per dag 2022-12-01 til 2022-12-06



Estimat m/ 95% konfidensintervall    Så langt denne måned    Absolutt nedre grense    • Daglig spotpris

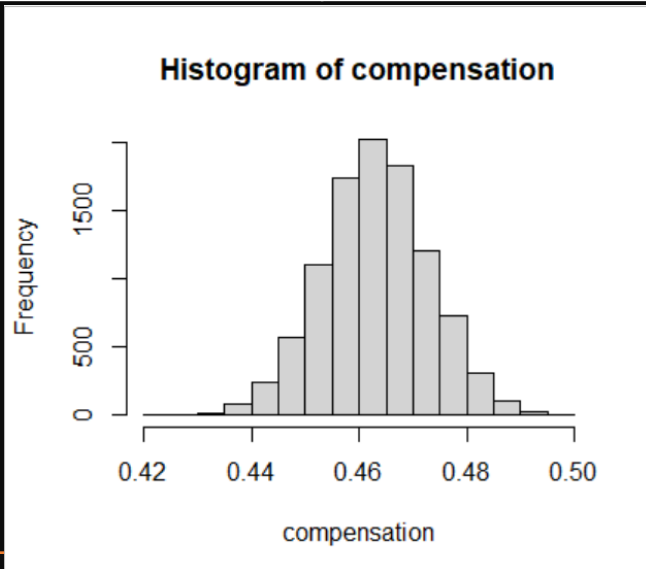
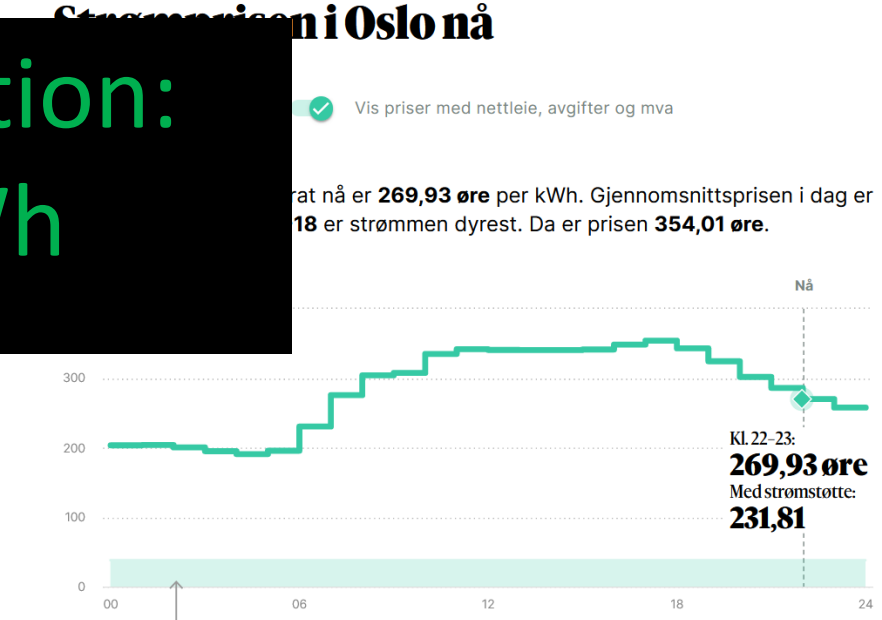


# Can we trust the uncertainty?



**Final compensation:  
0,48 NOK/kWh**

Confidence level	Historic cover
99%	94.6%
95%	93.7%
90%	90.9%
80%	84.2%
50%	56.5%



0 00 06 12 18  
Inkl. mva. Kilde: Nord Pool

**Strømsstøtten** ⓘ

Snittprisen så langt denne måneden har vært **118 øre/kWh** inkl. moms.

Med denne strømprisen blir strømsstøtten (90% over 70 øre ekskl. moms) slik:

Du betaler **91 øre** Inkl. moms

Strømsstøtte **28 øre**

**Anslått strømsstøtte**

Strømsstøtten denne måneden ligger an til å bli **38,11 øre** pr. kWh.

Anslaget for strømsstøtte er nokså sikkert nå i slutten av måneden, men ingen fasit. Sannsynligvis ender strømsstøtten et sted fra **37** til **39 øre** pr. kWh.

37 øre **38,11 øre** 39 øre

VGs anslag er at strømsstøtten for november ender et sted i dette området.

# The electricity bill contains more variable costs

• Bill =

$$\sum_{\text{time } t} [E_t * (S_t + I_t - C_0 + P_0)] + I_{const} + I_{effect} + P_{const}$$

- Spot price =  $S_t$ , and compensation =  $C_0$  is based on price area
- Infrastructure (nettleie)  $I_*$  is based on your adress
- $P_*$  is based on your chosen electricity provider
- The actual hourly electricity price is mainly geographically determined



GitHub Actions



# Dashboard

- Map costs to postal number
  - Merge geographical data on
    - Price areas
    - Areas covered by infrastructure provider
    - postal numbers
  - Fetch pricing lists for all infrastructure provider (NVE's API)

- Automatically updated compensation estimates
  - Every day at 13.15 via GitHub Actions
    - Fetch spot prices from NordPools API
    - Simulate spot price for the remaining days in month
    - Pushes to repo [github.com/martinju/stromstotte](https://github.com/martinju/stromstotte)

Interactive Shiny dashboard providing estimates of the actual hourly electricity price per postal number

[martinjullum.shinyapps.io/minstrompris](https://martinjullum.shinyapps.io/minstrompris)

Static compensation estimation site

[martinjullum.com/sideprojects/stromstotte/](https://martinjullum.com/sideprojects/stromstotte/)

