

Modeling and forecasting of electricity prices and demand

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Abstract

Goal of the thesis is to test models for demand and price forecasting for Danish day-ahead power market using regression method. Suggested models include expert models using different variables and different sets of rolling window and transformation method.

Keywords: electricity spot prices, day-ahead market, forecasting, power market
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1 Introduction

We have experienced big growth of wind power industry in the recent years and massive number of new installments of the wind turbines. Some countries have significantly increasing shares of renewable energy in the overall production. I will focus especially on a wind energy, which is becoming the most important source in some regions.

Better prognosis of the renewable energy production, consumption may have positive impact on the final predicted price of energy. Smaller errors may lead to economical profits for companies operating and buying energy on the power exchanges.

In this work I made a simulations in order to achieve the best forecasts of consumption and price for Danish market using day-ahead data. There are plenty of possible approaches using, i.e. regression models[13][10], neural networks[6][14], probabilistic methods[9]. I decided to use regression model with best fitting expert models from [2] implementing modifications of HP filter and testing different variations of expert models with different lengths of calibration window.

In the Chapter 2 I reviewed analysis of the Danish market. In the Chapter 3 I presented characteristics of available data provided by Nordpool power exchange. In the Chapter 4 I presented used methods to perform forecasts. In the Chapter 5 I presented empirical results of the all forecasts and in the last Chapter 6 I came up with conclusions.

2 Market analysis

Danish power market has been transformed in the last several years drastically. Since 70s there was a lot of investments in renewable sources of energy, especially in the field of wind power, and much more since 2002 when first large scale offshore wind farm in the world has been finished - Horns Rev 1 (160 MW). For year 2019, total wind power generation capacity was 6128 MW[7].

National target for 2020 is over 50% of a energy consumption covered by wind power and it's likely to be achieved, as in 2019 they obtained 47% of coverage by domestic production[3]. Moreover they have finished construction of next large scale wind farm Horns Rev 3 in August 2019[3]. There are also defined next goals in last presented national energy strategy. For wind power consumption they aim for 70% in 2030[3]. Denmark is currently leader of wind power shares in the national production and its development.

The production of such significant part of energy from wind carries some risk. Wind speed is very fluctuant and variable even in a day cycle. There are no perfect methods of forecasting in the long term periods. It may occur in higher (or lower) demand in production from other, stable sources of energy to cover consumption. It's problematic to mark a common trend in wind power forecasts¹. Thus it's helpful to correct prediction of electricity demand.

Wind power generation can't be stopped quickly as production of conventional

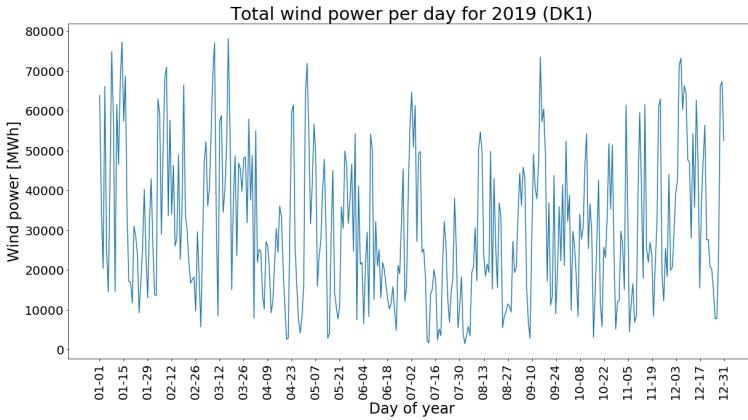


Figure 1: Wind power produced per day in 2019 (DK1)

sources of energy (coal, gas). Because of that higher unexpected wind power production may lead to decreased prices on energy stocks and in some cases, prices can drop below zero. That was happening rarely in the era of conventional production and regulated electricity market, but it happens more often with more renewable power generators. Because energy network is quite connected with each other in the European Union, in a case of negative prices energy from Danish areas (DK1, DK2) is exported to the neighboring countries, mainly to the Germany, which Denmark has the biggest balance of energy export and import.

Negative prices obligate to use other approaches of price forecasting, than the old ones which were failing with unexpected domain of values. In my work I will present a few models to forecast price and consumption and point out the best approach to have optimal forecasts.

The electricity market in Denmark is divided into 2 areas (DK1 and DK2). First area (DK1) consists of regions: Nordjylland, Midtjylland and Syddanmark; second area (DK2) consists of regions Sjælland and Hovedstaden with the capital Copenhagen.



Figure 2: Danish electricity market

3 Data analysis

Data I used to perform forecasts has been downloaded from the official webpage of the Nordpool power exchange[5]. Datasets are divided into the year files and periods (hours, weeks etc.). I managed to download following datasets (valid for the day 14.05.2020):

- Consumption - hourly
- Consumption prognosis - hourly
- Wind power - hourly
- Wind power prognosis - hourly
- Elspot prices (as Price) - hourly

All of the datasets were available for years 2013-2020, except for Consumption prognosis (2015-2020). So I decided to focus on analysis only on the period 2015-2020 (2015.01.01-2020.05.12), because 4 years time frame is still sufficient for calculations.

Units of downloaded data are following:

- Consumption and Wind Power- MWh
- Price - DKK/MWh

The files were downloaded, merged, split for regions DK1 and DK2, pivoted in order to have separated hours as parameters for each day and merged for all years. Example for consumption DK1 is presented below.

I performed a few analysis for each dataset, although I didn't include all of the charts and the tables in this work. The rest is uploaded into the github repository.

	date	holiday	0	1	2	...	22	23
0	2016-01-01	1	1818.0	1741.0	1660.0	...	1858.0	1713.0
1	2016-01-02	0	1615.0	1510.0	1461.0	...	2027.0	1822.0
2	2016-01-03	1	1724.0	1665.0	1671.0	...	2127.0	1998.0
3	2016-01-04	0	1844.0	1803.0	1789.0	...	2293.0	2079.0
4	2016-01-05	0	1940.0	1891.0	1952.0	...	2372.0	2193.0

Table 1: First 5 rows of merged file Consumption DK1.

3.1 Missing values

Data was very consistent and yet only single values were missing. These null values were replaced by average of the neighboring cells and in case of missing value in neighbor cell, value was fixed manually (with file `fill_empty_cells.py`). Half of day 2018-09-18 from Wind prognosis files was filled taking closest neighbors and counting average for whole vector (with file `fill_empty_cells_wind_prognosis_DK.py`). Number of missing values was reduced to zero.

Dataset	DK1	DK2
Consumption	5	5
Consumption prognosis	5	5
Price	21	12
Wind power	12	6
Wind power prognosis	18	19

Table 2: Missing values in files.

3.2 Consumption data

Electricity consumption was higher in the area DK1 than DK2, compared for years 2016-2019 19.14, 19.41, 20.28, 20.37 TWh to 13.13, 13.03, 13.28, 13.16 TWh accordingly. We can see that consumption increased gradually in the area DK1, meanwhile in area DK2 was on the similar level.

We can spot three types of seasonal trends in the data: annual, weekly and daily. On the below chart showing consumption per day in 2019, we see that every weekend consumption value drops.

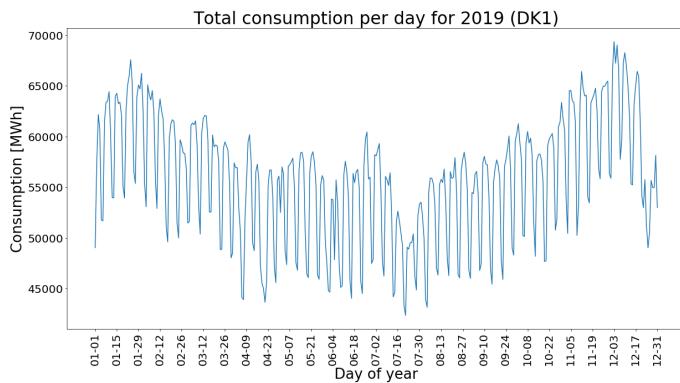


Figure 3: Consumption per day in 2019 (DK1)

Although it's not easy to spot in the DK1, there is annual trend with lower consumption during summer months and higher during winter. It's observable particularly in the DK2.

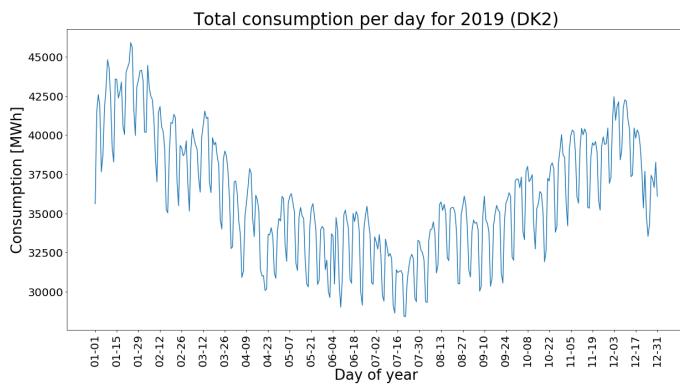


Figure 4: Consumption per day in 2019 (DK2)

Simple moving average with 14 days windows for each year shows clearly this trend. Although in the area DK1 it's not very sharp.

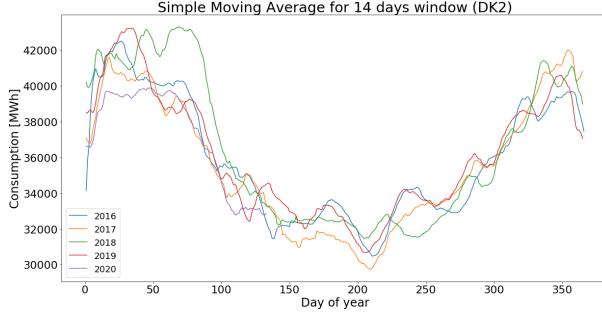


Figure 5: Simple moving average of consumption - 14 days window (DK2)

Last seasonal trend is daily which can be observed for each day of a week, even holidays. There are two peaks of energy consumption each day, in the morning and evening. During weekends and holidays, morning peaks are slightly shifted than during work days. There is also noticeable smaller consumption in the night.

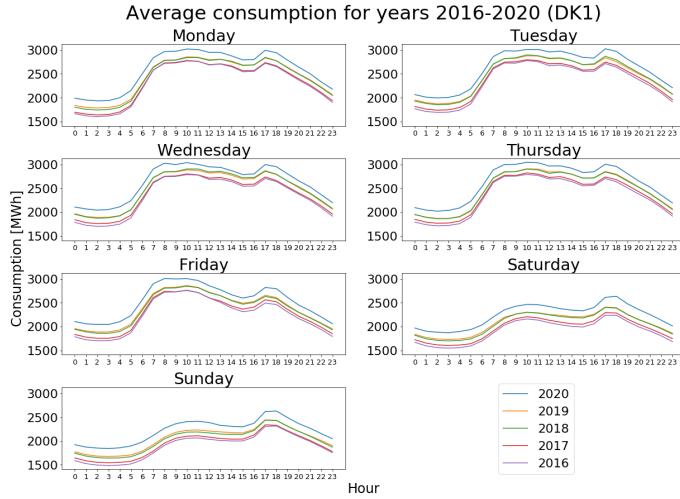


Figure 6: Average consumption per each hour of day for each day of week (DK1)

There is also one interesting thing observed in the 2020's data only in the area DK2. Evening daily peak is slightly shifted which can be caused epidemic COVID-19 or incomplete data of 2020 year.

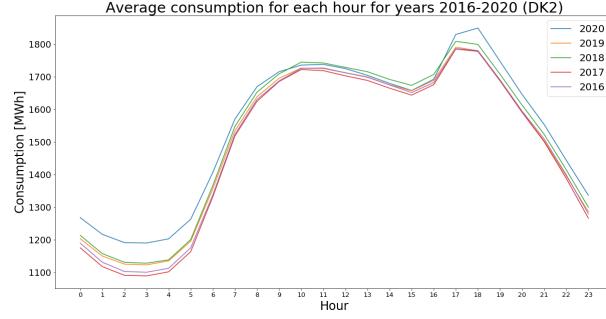


Figure 7: Average consumption per each hour of day for each year (DK2)

3.2.1 Nordpool's prognosis

The prognosis day-ahead given by Nordpool shows that those are less accurate over time, especially for area DK1 where consumption is larger than DK2. Level of accuracy for area DK2 is quite stable. Also there is no clear trend regarding the time of day. For DK1 best prediction are for night and for DK2 best prediction are performed for hours 7 and 15.

Area	Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
DK1	2016	18.7	15.2	13.2	12.7	12.3	14.1	18.7	19.5	20.3	19.6	19.6	19.7	20.4	19.0	16.5	16.9	16.0	18.7	17.7	15.9	16.0	15.0	13.7	17.3	16.9
	2017	16.1	24.9	19.0	13.9	14.1	15.1	18.7	18.7	19.1	19.9	19.8	17.8	16.3	15.4	15.1	16.1	21.1	22.1	20.7	17.2	18.0	17.5	19.4	22.5	18.3
	2018	18.8	26.7	17.7	15.9	14.1	15.9	20.6	24.8	21.0	23.6	21.3	20.1	22.5	21.0	20.9	19.8	19.2	21.7	18.3	19.9	24.9	22.5	23.1	25.8	20.8
	2019	22.0	29.3	21.8	17.9	17.2	18.1	23.0	24.9	22.0	27.3	24.7	22.7	23.0	20.6	19.2	19.2	20.2	21.5	22.6	22.4	25.2	24.0	25.1	30.3	22.7
	2020	21.7	26.9	23.4	20.5	16.8	20.5	34.8	34.2	26.4	32.8	32.9	22.6	22.2	27.4	24.6	22.2	22.3	36.1	32.4	23.6	26.4	24.5	27.7	32.4	26.5
	Total	19.1	24.3	18.4	15.5	14.6	16.2	21.4	23.0	21.1	23.5	22.3	20.3	20.7	19.7	18.5	18.3	19.4	22.2	20.9	19.2	21.5	20.1	20.9	24.7	20.2

Figure 8: MAE for consumption for each hour and year with total figures (DK1)

Area	Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
DK2	2016	23.8	19.6	19.0	20.3	22.4	22.9	20.9	17.1	23.6	27.6	24.3	21.4	24.1	22.0	20.0	19.2	23.3	26.4	24.5	22.9	24.5	24.6	20.7	15.9	22.1
	2017	19.6	21.9	21.7	20.2	18.8	18.5	22.7	16.8	20.2	21.8	21.6	20.8	20.2	20.5	20.6	16.7	18.0	24.4	23.3	21.2	20.8	22.8	22.8	27.4	21.0
	2018	18.1	25.2	24.7	20.8	19.5	20.2	27.5	18.8	21.2	24.8	26.8	26.7	27.0	26.1	22.4	17.5	20.7	24.7	22.5	22.4	26.8	29.1	25.9	23.2	23.4
	2019	16.1	23.9	22.8	17.5	16.3	15.9	21.2	14.3	16.9	17.9	21.2	21.6	18.6	17.5	17.1	15.3	18.7	24.5	22.1	18.8	22.2	22.6	21.1	22.7	19.5
	2020	17.4	18.2	15.8	12.4	15.0	17.6	25.5	22.1	24.4	31.0	36.4	27.6	23.5	26.0	21.7	13.9	15.9	28.1	27.5	18.3	17.2	17.1	14.6	18.9	21.1
	Total	19.2	22.3	21.5	19.1	18.9	19.2	23.3	17.2	20.8	23.7	24.5	23.0	22.6	21.9	20.1	16.9	19.8	25.3	23.5	21.1	23.1	24.1	22.0	22.0	21.5

Figure 9: MAE for consumption for each hour and year with total figures (DK2)

3.3 Wind power data

Wind power production increased significantly within last 4 years. In the area DK1 from 9.41 to 11.26 TWh and for area DK2 from 2.37 to 3.22 TWh, so about 35% more.

So far in the consumption data we could spot trends whereas in the wind power data there is no distinct trend.

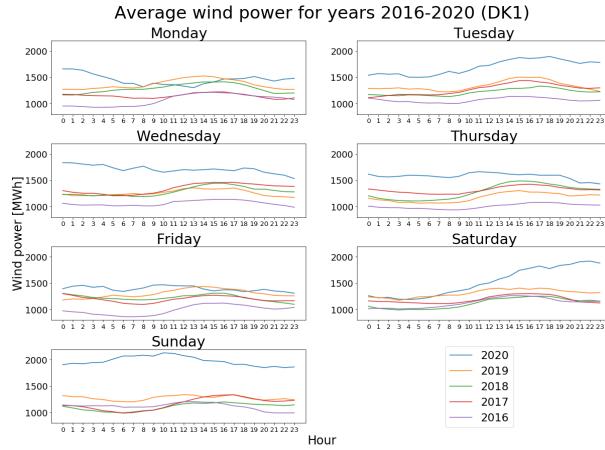


Figure 10: Wind power production per hour of a day for each day of week (DK1)

Simple moving average also doesn't show anything recurrent, thus we can't assume any annual trend.

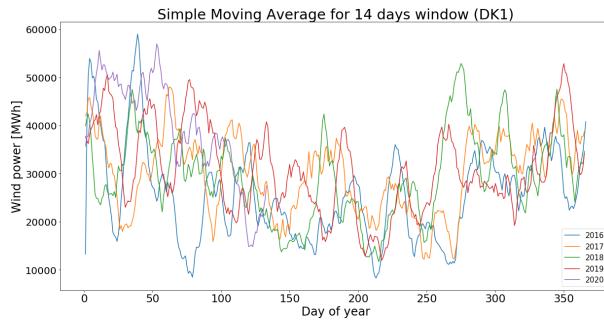


Figure 11: Simple moving average of wind power production for each day of the year (DK1)

Only chart of average wind power for each hour suggest there may be a daily trend, however data from area DK2 doesn't confirm this assumption.

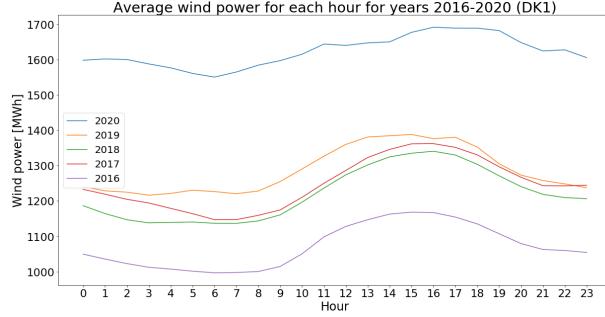


Figure 12: Average wind power production per hour of a day for each year (DK1)

3.3.1 Nordpool's prognosis

I calculated mean absolute error for prognosis performed by Nordpool for each hour and year. The results for area DK1 are rounded to the whole number. We can spot that error for prognosis is bigger for newer data with over 80% growth in 2020 (until 12th May) comparing to the previous year. Another thing we can notice that the error in the night hours is lower than others.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total	
Area	Year																									
	2016	125	131	133	134	141	145	144	152	155	157	164	163	163	180	191	194	189	189	187	189	185	186	182	180	165
	2017	152	156	161	158	162	166	167	170	169	168	183	196	197	198	199	202	204	202	197	194	194	195	199	200	183
	2018	154	149	150	156	155	156	162	162	174	175	184	186	192	201	209	217	225	215	207	211	208	207	210	227	187
	2019	216	216	208	213	217	219	221	217	218	217	226	229	238	249	253	255	261	255	256	241	232	240	246	258	233
	2020	410	379	381	389	401	400	425	411	381	382	386	404	431	429	451	447	484	470	432	424	437	455	449	462	422
	Total	182	181	181	184	188	191	194	195	196	196	205	211	217	225	233	236	242	236	230	227	224	227	229	237	211

Figure 13: MAE for wind power and Nordpool prognosis for each hour and year (DK1)

The results for area DK2 are similar, however numbers are smaller due to the lower capacity of wind farms in this part of Denmark.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total	
Area	Year																									
	2016	45.7	45.7	45.9	45.0	47.4	48.7	50.3	51.5	50.6	49.1	49.6	52.2	49.6	49.9	51.5	51.3	53.2	58.0	60.8	59.4	59.4	60.7	65.5	66.1	52.8
	2017	55.5	57.4	57.1	56.5	53.7	54.7	56.0	56.3	59.7	60.0	62.2	65.0	67.9	70.0	67.1	68.9	68.2	68.8	70.1	72.6	72.2	70.4	68.3	69.3	63.7
	2018	52.5	54.2	53.9	54.1	55.2	56.4	56.2	59.5	60.7	60.1	60.1	62.5	60.9	59.2	59.8	65.1	67.3	73.6	75.4	70.7	70.9	68.5	66.6	69.6	62.2
	2019	58.4	60.0	56.5	58.1	55.2	55.1	56.7	60.3	64.2	62.9	66.3	67.7	65.9	65.1	63.5	64.9	67.6	69.6	71.0	68.6	67.9	72.4	73.6	73.4	64.4
	2020	68.6	66.1	65.7	67.2	66.7	66.6	64.3	63.7	61.1	72.8	73.0	70.1	74.4	79.9	78.6	76.9	87.7	84.3	78.0	76.6	82.5	87.8	89.8	96.0	74.9
	Total	54.3	55.3	54.4	54.6	54.0	54.8	55.6	57.5	59.0	59.3	60.7	62.5	62.2	62.6	62.0	63.7	66.0	68.9	70.0	68.5	68.8	69.7	70.3	71.8	61.9

Figure 14: MAE for wind power and Nordpool prognosis for each hour and year (DK2)

3.4 Price data

In the 2020 price of energy decreased compared to the previous years. However we don't know what kind of the impact had epidemic on this data so it's hard to come up

with any conclusion.

Year	DK1	DK2
2016	184.435	206.825
2017	224.005	227.575
2018	329.235	339.345
2019	289.270	295.390
2020	142.520	149.865

Table 3: Average price of energy per each year (DKK/MWh)

As in the consumption data we can also notice seasonal trends in this category, but this time only two kinds: daily and weekly. There is no annual trend in the price data.

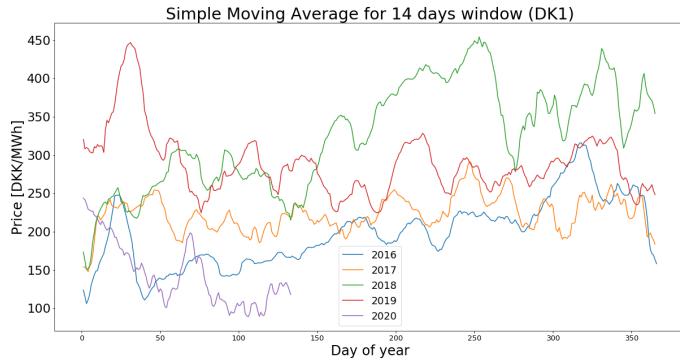


Figure 15: Simple moving average of price for each year - 14 days window (DK1)

Electricity prices are lower during weekends due to the lower consumption and there are also 2 daily peaks each day, either weekend (including holidays) and work days.

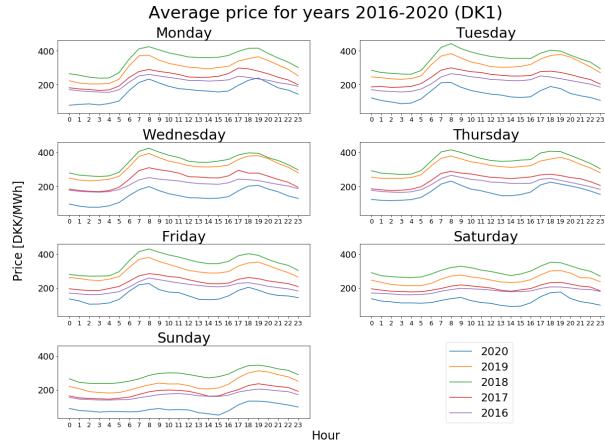


Figure 16: Average price per hour of a day for each day of week (DK1)

3.4.1 Negative prices

There were 417 negative prices in the area DK1 in the years 2016-2020 and 288 in the DK2. The dataset for 2020 ends on 12th May, however there are already 84 negative prices compared to the 133 in the full year 2019. Negative prices occur more often during nights than the peaks of consumption. It shows that DK2 is more balanced than DK1.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
year																									
2016	3	7	8	8	6	4	5	2	1	1	0	0	1	2	3	2	2	1	0	0	1	2	0	4	63
2017	6	6	8	7	6	5	6	4	1	2	2	2	2	4	4	5	4	0	0	0	1	3	3	4	85
2018	4	5	5	6	7	6	6	3	0	0	1	0	1	2	2	1	0	0	0	0	0	1	0	2	52
2019	9	9	12	14	11	5	6	4	3	3	4	3	6	9	11	8	4	2	1	1	1	1	1	5	133
2020	5	3	6	7	7	7	4	3	2	2	4	3	3	4	6	7	6	1	1	0	0	1	1	1	84
Total	27	30	39	42	37	27	27	16	7	8	11	8	13	21	26	23	16	4	2	1	3	8	5	16	417

Figure 17: Number of negative prices for each hour, year and totally (DK1)

3.4.2 Correlation between price and wind power

We can suspect that with bigger values of wind power price is lower. Pearson's correlation shows that mostly it's weak correlation, only for 2020 year there are moderate values.

Correlation is a little bit higher for night hours than rest of the day.

Area	Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
	2016	-0.41	-0.42	-0.41	-0.41	-0.40	-0.36	-0.36	-0.40	-0.44	-0.44	-0.42	-0.41	-0.40	-0.39	-0.38	-0.37	-0.37	-0.35	-0.35	-0.41	-0.43	-0.38	-0.37	-0.37	-0.37
	2017	-0.62	-0.62	-0.61	-0.58	-0.54	-0.52	-0.46	-0.46	-0.51	-0.53	-0.53	-0.55	-0.56	-0.54	-0.53	-0.51	-0.50	-0.51	-0.60	-0.63	-0.62	-0.60	-0.62	-0.61	
DK1	2018	-0.45	-0.46	-0.49	-0.50	-0.48	-0.44	-0.36	-0.38	-0.42	-0.44	-0.46	-0.45	-0.43	-0.41	-0.40	-0.39	-0.42	-0.41	-0.45	-0.46	-0.44	-0.46	-0.47	-0.48	
	2019	-0.50	-0.50	-0.52	-0.53	-0.51	-0.46	-0.37	-0.38	-0.39	-0.41	-0.42	-0.41	-0.40	-0.38	-0.35	-0.33	-0.34	-0.40	-0.51	-0.56	-0.56	-0.56	-0.56	-0.56	
	2020	-0.53	-0.63	-0.81	-0.84	-0.83	-0.83	-0.72	-0.68	-0.69	-0.69	-0.68	-0.64	-0.68	-0.69	-0.72	-0.74	-0.75	-0.73	-0.72	-0.72	-0.69	-0.65	-0.69	-0.73	
	2016	-0.36	-0.40	-0.41	-0.40	-0.34	-0.29	-0.27	-0.23	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.23	-0.18	-0.19	-0.24	-0.28	-0.31	-0.31	-0.28	-0.32	
	2017	-0.61	-0.61	-0.61	-0.61	-0.57	-0.50	-0.45	-0.42	-0.42	-0.43	-0.44	-0.46	-0.44	-0.43	-0.42	-0.38	-0.37	-0.37	-0.42	-0.47	-0.53	-0.58	-0.62	-0.63	
DK2	2018	-0.52	-0.53	-0.53	-0.53	-0.51	-0.48	-0.39	-0.31	-0.30	-0.30	-0.35	-0.38	-0.36	-0.35	-0.34	-0.33	-0.33	-0.34	-0.38	-0.40	-0.4	-0.47	-0.50		
	2019	-0.50	-0.52	-0.52	-0.52	-0.49	-0.42	-0.31	-0.32	-0.31	-0.28	-0.26	-0.25	-0.25	-0.25	-0.23	-0.23	-0.24	-0.26	-0.27	-0.44	-0.48	-0.46	-0.49	-0.50	
	2020	-0.50	-0.46	-0.43	-0.35	-0.39	-0.51	-0.58	-0.38	-0.39	-0.40	-0.35	-0.40	-0.38	-0.34	-0.31	-0.29	-0.32	-0.38	-0.36	-0.43	-0.53	-0.64	-0.75	-0.75	

Figure 18: Correlation between price and wind power for each hour and year (DK1 and DK2)

3.5 Holidays

Usage of the electricity decreases during weekends and public holidays and this has a significant effect on a prediction especially during Christmas or Easter. Due to that fact, each day was aligned with variable holiday with following value based of occurrence of day of week or public holiday:

- 1 - National Holidays (e.g. Easter Monday)[12]
- 1 - Sundays
- 0 - Not a public holidays (e.g. New Year's Eve)
- 0 - Other days

Each holiday is treated in weekday dummies as a Sunday.

4 Methodology

I decided to choose Danish market for forecasting and so on I want to apply methods and models most fitting to the characteristics of this market. I performed forecasting for 3 categories of values: wind power, consumption and price. In each category I made prognosis for few models which are described in Forecasting section. My forecasting framework for all of them is following:

1. Data preparation
2. Preliminary data analysis
3. Data forecasting (cycle for each model and day)
 - Optional deseasonalization
 - Data normalization
 - Day-ahead forecasting

4. Verifying models' performance

All calculations were conducted with Python 3.7 language and its libraries, i.e. numpy, pandas, scipy. All the scripts and results made are accessible in public GIT repository <https://github.com/ajescode/energyForecast>.

Wind power prognosis and Consumption prognosis is provided only one day in advance so data forecasting is also performed day ahead. I used 3 calibration windows to compute predictions. They may take values of week multiples (7 days) because of the seasonal trend of energy production. Because chosen data has a limit of 1583 days, the maximum calibration window I considered is 728 days, around 2 years.

I consider few models for each category of forecasts (consumption, price and wind power) which I explain later in this section. General equation for each model (except of benchmark models for wind power and consumption) can be presented as:

$$\hat{Y}_{d,h} = \sum_{i=1}^n \beta_{d,h,i} X_{d,h}^i, \quad (1)$$

where $Y_{d,h}$ is prediction and $X_{d,h}^i$ is variable for given day (d) and hour (h). We can predict values for next whole day only, but basing on the variables from whole calibration window. Coefficients $\beta_{h,i}$ have been approximated by ordinary least squares (OLS).

$$\vec{\beta} = (X^T X)^{-1} X^T Y, \quad (2)$$

where X is matrix of independent variables, and Y is vector of dependant variables of size of calibration window (multiple of 7 days).

Because prices of energy due to the wind dependence can have negative values I needed to normalize values. I used function *asinh* which was empirically confirmed to have best results for danish market among 4 different normalization functions.[1].

$$X_{d,h} = \text{asinh}(x_{d,h}) \equiv \log(x_{d,h} + \sqrt{x_{d,h}^2 + 1}), \quad (\text{asinh})$$

where $Y_{d,h}$ is transformed value used for forecasts either as independent variable or dependent variable. Independent values in the model must be also transformed. $y_{d,h}$ is normalized in a calibration window by:

$$x_{d,h} = \frac{1}{b_{d,h}}(x_{d,h}^* - a_{d,h}), \quad (\text{std})$$

where a is median and b is median absolute deviation (MAD) for given day and hour in the calibration window. $y_{d,h}^*$ is original value of a parameter without any transformation yet. I used both simple normalization (std), and one with *asinh* function (asinh) for each category of forecasting.

Inverse function for transformation and normalization is following:

$$x_{d,h}^* = b_{d,h} \sinh(X_{d,h}) + a_{d,h}, \quad (3)$$

To eliminate seasonal component from the data I applied Hodrick-Prescott filter[15] before standard normalization with smoothing parameter derived from Ravn and Uhlig (2002) [11] and adjusted to the daily data as $1600^4 * 6.25 = 110930628906.25$. Similar method as the eliminating of seasonal component is also used in other works, i.e. Nowatorski, Weron 2016[8].

Types of transformations used (simple standard normalization is default without any name on the charts):

1. None: Standard normalization (std)
2. Asinh: Standard normalization (std) + asinh (asinh)
3. Asinh-hp: Standard normalization (std) + asinh (asinh) + HP filter
4. HP: Standard normalization (std) + HP filter

Despite of used transformations, the forecasts were performed with several different settings for each area (DK1 and DK2):

- Calibration window: 182, 364, 728
- Predicted dates: 2019.01.01-2019.12.31 (2019 year),
2019.05.13-2020.05.12 (last year),
2020.01.01-2020.05.12,
2019.01.01-2020.05.12

4.1 Demand forecasting

First considering model is a benchmark model containing consumption forecast provided by Nordpool's database for day ahead ($FL_{t,h}$). Its performance is analyzed in the section Demand data prognosis.

$$C_{d,h} = FC_{d,h} \quad (\text{C1})$$

Second model is extension of benchmark model (C1), where D_i, d is a vector of the values 0,1 for the corresponding day of a week. For day (d) which is Monday $D_{1,d} = 1$ and $D_{2,d} = D_{3,d} = \dots = D_{7,d} = 0$, for a day which is Tuesday $D_{2,d} = 1$ and $D_{1,d} = D_{3,d} = \dots = D_{7,d} = 0$ etc.

$$C_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 FC_{d,h} + \varepsilon_{d,h} \quad (\text{C2})$$

Third model is extension of second model (C2), where are added 3 parameters according to a similar-day technique: consumption of previous day ($C_{d-1,h}$), 2 days ago ($C_{d-2,h}$) and week ago ($C_{d-7,h}$).

$$C_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 F C_{d,h} + \beta_2 C_{d-1,h} + \beta_3 C_{d-2,h} + \beta_4 C_{d-7,h} + \varepsilon_{d,h} \quad (\text{C3})$$

Fourth model is extension of third model (C3) where is also considered forecast of the wind power download from Nordpool's database, denoted as $FW_{d,h}$.

$$C_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 F C_{d,h} + \beta_2 C_{d-1,h} + \beta_3 C_{d-2,h} + \beta_4 C_{d-7,h} + \beta_5 FW_{d,h} + \varepsilon_{d,h} \quad (\text{C4})$$

4.2 Wind power forecasting

First model is presented and analyzed in the section *Wind power data prognosis*. This is a benchmark model for further forecasts, where $FW_{t,h} + \varepsilon_t$ is a day ahead forecast of wind power taken from Nordpool's data.

$$W_{t,h} = FW_{t,h} \quad (\text{W1})$$

Second model includes additionally day of week vector as the second demand model (C2).

$$W_{t,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta FW_{t,h} + \varepsilon_{d,h} \quad (\text{W2})$$

Third model is extension of second model (W2) and contains also wind power from previous day ($W_{t-1,h}$) and 2 days ago ($W_{t-2,h}$) from the corresponding hour.

$$W_{t,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 FW_{t,h} + \beta_2 W_{t-1,h} + \beta_3 W_{t-2,h} + \varepsilon_{d,h} \quad (\text{W3})$$

Fourth model is extension of third one (W3) and contains additionally parameter of consumption forecast from previous day denoted as $FL_{t,h}$.

$$W_{t,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 FW_{t,h} + \beta_2 W_{t-1,h} + \beta_3 W_{t-2,h} + \beta_4 FC_{t,h} + \varepsilon_{d,h} \quad (\text{W4})$$

4.3 Price forecasting

First forecasting model of price consists of the same day of week vector ($D_{i,d}$) as the second demand model (C2).

$$P_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \varepsilon_{d,h} \quad (\text{P1})$$

Second model is an extension of first model (P1), where were added parameters of price for previous days: 1 day ago, 2 days ago and 1 week ago.

$$P_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 p_{d-1,h} + \beta_2 p_{d-2,h} + \beta_3 p_{d-7,h} + \varepsilon_{d,h} \quad (\text{P2})$$

Third model is an extension of second model (P2) which consists additionally parameters of minimum ($p_{d-1,min}$) and maximum value ($p_{d-1,max}$) of previous day and value of price for last hour of previous day ($p_{d-1,24}$).

$$P_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 p_{d-1,h} + \beta_2 p_{d-2,h} + \beta_3 p_{d-7,h} + \beta_4 p_{d-1,min} + \beta_5 p_{d-1,max} + \beta_6 p_{d-1,24} + \varepsilon_{d,h} \quad (4)$$

Fourth model is an extension of third model (4) which is an expert model ARX2[4] with two exogenous variables: wind power prognosis ($FW_{d,h}$) and consumption prognosis ($FC_{d,h}$).

$$\begin{aligned} P_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 p_{d-1,h} + \beta_2 p_{d-2,h} + \beta_3 p_{d-7,h} + \beta_4 p_{d-1,min} + \beta_5 p_{d-1,max} \\ + \beta_6 p_{d-1,24} + \beta_7 FW_{d,h} + \beta_8 FC_{d,h} + \varepsilon_{d,h} \end{aligned} \quad (\text{P4})$$

In the last fifth model, Nordpool's prognosis for wind and consumption are replaced with the best forecasts acquired from the wind and consumption prognosis. However only values in predicted period were replaced by better prognosis, not full rolling window, that's why eventually it wasn't very efficient.

Different models for different periods and areas were used. Summary of best models used were presented in next chapter.

$$\begin{aligned} P_{d,h} = \sum_{i=1}^7 \beta_{0,i} D_{i,d} + \beta_1 p_{d-1,h} + \beta_2 p_{d-2,h} + \beta_3 p_{d-7,h} + \beta_4 p_{d-1,min} + \beta_5 p_{d-1,max} \\ + \beta_6 p_{d-1,24} + \beta_7 FW_{d,h}^* + \beta_8 FC_{d,h}^* + \varepsilon_{d,h} \end{aligned} \quad (\text{P5})$$

5 Empirical results

For each forecast there is error analysis with Mean average error (MAE), Mean root square error (MRSE). All forecasts in the appropriate categories are compared to each other in order to get optimal result.

$$MAE = \frac{1}{24T} \sum_{d=1}^T \sum_{h=1}^{24} |\hat{\varepsilon}_{d,h}| \equiv \frac{1}{24T} \sum_{d=1}^T \sum_{h=1}^{24} |y_{d,h} - \hat{y}_{d,h}|, \quad (5)$$

$$RMSE = \sqrt{\frac{1}{24T} \sum_{d=1}^T \sum_{h=1}^{24} \hat{\varepsilon}_{d,h}^2} \equiv \sqrt{\frac{1}{24T} \sum_{d=1}^T \sum_{h=1}^{24} (y_{d,h} - \hat{y}_{d,h})^2}, \quad (6)$$

where T is size of calibration window.

From each consumption, wind and price prognosis were chosen the best results for each period and area and performed Diebold-Mariano test based on MAD criterion.

5.1 Demand forecasts

For both areas results with *asinh* were significantly worse than with standard normalization function. Especially for calibration window 182. The forecast with standard normalization was better for Models 2-4 than Nordpool's prognosis, however better accuracy was for longer calibration windows. Because drops of consumption level in 2020 results including this period were less accurate.

Area	Dates	Window	C1	C2	C2 (asinh)	C2 (asinh-hp)	C2 (hp)	C3	C3 (asinh)	C3 (asinh-hp)	C3 (hp)	C4	C4 (asinh)	C4 (asinh-hp)	C4 (hp)
		182	22.7044	21.0269	21.2785	24.1466	23.8343	21.3643	21.6734	24.3640	24.0067	21.4608	21.8100	24.5258	24.1166
	2019.01.01-2019.12.31	364	22.7044	20.5738	20.6452	36.0889	36.0494	20.6044	20.7099	36.2072	36.1524	20.6357	20.7542	36.2376	36.1422
		728	22.7044	20.4818	20.5553	59.5941	59.5155	20.4128	20.5007	59.3679	59.5639	20.3765	20.4789	59.4302	59.6149
		182	23.7079	21.9972	22.3086	24.7041	24.3825	23.3403	22.6712	24.9615	24.5930	22.4058	22.7671	25.0662	24.6507
	2019.01.01-2020.05.12	364	23.7079	21.6325	21.6570	35.8995	35.7843	21.7035	21.7714	35.8886	35.8010	21.6997	21.7899	35.8401	35.7073
		728	23.7079	21.5292	21.5643	60.5532	60.5344	21.4925	21.5529	60.4016	60.4206	21.4406	21.5306	60.1393	60.0978
DK1		182	24.5221	22.8302	23.0908	25.4669	25.1809	23.6119	23.4355	25.6814	25.3691	23.2260	23.5189	25.7723	25.4160
	2019.05.13-2020.05.12	364	24.5221	22.4451	22.4610	36.5130	36.3555	22.5117	22.5626	36.5040	36.3466	22.4685	22.5485	36.5255	36.3288
		728	24.5221	22.3265	22.3395	61.6104	61.6029	22.9986	22.3290	61.4345	61.4787	22.2225	22.2967	61.0137	60.9890
		182	26.4619	26.6599	25.1339	26.2342	25.8871	25.0187	25.4097	26.6014	26.2021	24.9993	25.3940	26.5495	26.1163
	2020.01.01-2020.05.12	364	26.4619	24.5378	24.4340	35.7996	35.5566	24.7197	24.6847	35.0143	34.8365	24.6198	24.6324	34.7494	34.5140
		728	26.4619	24.4039	24.3334	63.1851	62.6947	24.4557	24.4404	63.2386	62.7718	24.3607	24.4166	62.0852	61.4231

Figure 19: MAE on the consumption forecasts (DK1)

Area	Dates	Window	C1	C2	C2 (asinh)	C2 (asinh-hp)	C2 (hp)	C3	C3 (asinh)	C3 (asinh-hp)	C3 (hp)	C4	C4 (asinh)	C4 (asinh-hp)	C4 (hp)
		182	19.4739	18.5070	19.1465	19.0951	18.4566	18.6114	19.0274	18.9975	18.1329	18.2866	19.2230	19.2031	18.2637
	2019.01.01-2019.12.31	364	19.4739	17.8111	17.7460	17.7535	17.7854	17.6134	17.9143	17.9818	17.6679	17.7855	18.1222	18.2021	17.8651
		728	19.4739	17.6512	17.6094	18.0666	18.0412	17.3886	17.5390	18.0941	17.8905	17.5472	17.7300	18.2579	18.0342
		182	19.8874	18.5865	19.2647	19.2070	18.5321	18.2830	19.1055	19.0654	18.2456	18.3780	19.2632	18.2462	
	2019.01.01-2020.05.12	364	19.8874	18.2011	18.1744	18.1461	18.1316	18.0487	18.3232	18.3318	18.0357	18.1626	18.4691	18.4902	18.1706
		728	19.8874	18.2647	18.2180	18.5074	18.4816	18.6022	18.1930	18.5798	18.3977	18.1841	18.3504	18.7252	18.5168
DK2		182	18.9997	17.5838	18.2321	18.1748	17.5352	17.1995	17.8265	17.7952	17.1671	17.2685	17.9523	17.9228	17.2436
	2019.05.13-2020.05.12	364	18.9997	17.4321	17.4237	17.3046	17.2799	17.2091	17.3354	17.3093	17.1650	17.2150	17.3602	17.3477	17.1868
		728	18.9997	17.4156	17.3765	17.5042	17.4841	17.2369	17.3201	17.6461	17.5203	17.3067	17.4280	17.7438	17.5863
		182	21.0221	18.8044	19.5993	19.5139	18.7391	18.6167	19.3198	19.2518	18.5548	18.6288	19.3735	19.2918	18.5725
	2020.01.01-2020.05.12	364	21.0221	19.2717	19.3505	19.2236	19.0818	19.2435	19.4456	19.2923	19.0451	19.1973	19.4211	19.2809	19.0090
		728	21.0221	19.9481	19.8869	19.7163	19.6904	19.9111	19.9880	19.9126	19.7895	19.9320	20.0529	20.0076	19.8412

Figure 20: MAE on the consumption forecasts (DK2)

Area	Dates	Window	C1	C2 (asinh)	C2 (asinh-hp)	C2 (hp)	C3	C3 (asinh)	C3 (asinh-hp)	C3 (hp)	C4 (asinh)	C4 (asinh-hp)	C4 (hp)	
			182	36.9021	35.1851	35.3440	37.6028	37.3393	35.4515	35.6229	37.7305	37.4808	35.4539	35.6312
2019.01.01-2019.12.31	364	36.9021	34.8179	34.8509	47.3679	47.2368	34.7848	34.8236	47.4697	47.3370	34.7550	34.8095	47.5017	47.3267
	728	36.9021	34.7436	34.7824	68.0356	68.1554	34.6753	34.7107	67.8902	67.9854	34.6132	34.6703	67.9224	68.0114
	182	36.7802	34.9363	35.1362	37.0798	36.8179	35.2543	35.4395	37.3173	37.0468	35.2632	35.4683	37.3735	37.0368
	364	36.7802	34.6373	34.6133	46.5772	46.4119	34.6808	34.6729	46.5696	46.4417	34.6375	34.6675	46.5427	46.3598
DK1	728	36.7802	34.5603	34.5601	68.6243	68.5919	34.5378	34.5361	68.5395	68.4949	34.4697	34.5156	68.3048	68.2087
	182	39.3265	37.4799	37.5582	39.3605	39.2253	37.7994	37.8761	39.5733	39.4245	37.7968	37.8899	39.6054	39.3842
	364	39.3265	37.2244	37.1853	48.5201	48.3321	37.2624	37.2402	48.5115	48.3304	37.1906	37.2170	48.5104	48.2850
	728	39.3265	37.1387	37.1166	70.158	70.5985	37.1220	37.0905	70.4420	70.3902	37.0382	37.0709	70.0604	69.9530
2019.05.13-2020.05.12	182	36.4434	34.2443	34.5594	35.6050	35.3475	34.7072	34.9315	36.1592	35.8289	34.7344	35.0176	36.2513	35.7201
	364	36.4434	34.1367	33.9527	44.3350	44.0687	34.9340	34.2557	44.0049	43.8910	34.3130	34.2750	43.8031	43.5964
	728	36.4434	34.0522	33.9424	70.2144	69.7799	34.1577	34.0524	70.2905	69.8741	34.0730	34.0876	69.3434	68.7471

Figure 21: RMSE on the consumption forecasts (DK1)

Area	Dates	Window	C1	C2 (asinh)	C2 (asinh-hp)	C2 (hp)	C3	C3 (asinh)	C3 (asinh-hp)	C3 (hp)	C4 (asinh)	C4 (asinh-hp)	C4 (hp)	
			182	28.3419	26.0223	25.9419	26.1023	26.1619	25.2956	25.6072	25.7888	25.4555	25.5330	25.8912
2019.01.01-2019.12.31	364	28.3419	25.9872	25.9431	26.5737	26.5666	25.1838	25.3110	25.9992	25.8112	25.3099	25.4714	26.1508	25.9294
	728	28.3419	25.9872	25.9431	28.1959	28.1903	27.5225	26.8667	27.8857	27.8809	26.8643	27.0062	28.1566	28.1553
	182	29.4301	27.5234	28.1959	28.1903	27.5225	26.8667	27.8857	27.8809	26.8643	27.0062	28.1566	27.0045	
	364	29.4301	27.1706	27.1300	27.2239	27.2374	26.4286	26.4513	26.9463	26.8598	26.5347	26.8127	26.9255	26.6226
DK2	728	29.4301	27.3285	27.2664	27.6885	27.6941	26.4286	26.4513	26.9463	26.8598	26.5347	26.8127	27.0935	26.9706
	182	28.0782	26.0545	26.7303	26.7120	26.0410	25.9664	26.1364	26.1275	25.3848	25.4814	26.2855	26.2807	25.4729
	364	28.0782	25.9346	25.9279	25.9514	25.9351	25.2422	25.2880	25.3993	25.2849	25.2366	25.3395	25.4121	25.2846
	728	28.0782	25.9816	25.9366	26.2186	26.2190	25.2271	25.1870	25.6051	25.5894	25.2853	25.2830	25.6968	25.6474
2019.05.13-2020.05.12	182	32.2284	29.6137	30.3570	30.3026	29.5657	29.9411	29.5000	29.5201	28.8928	28.9598	29.6497	29.6070	28.9111
	364	32.2284	30.0975	30.1510	30.0880	29.9914	29.2027	29.2406	29.1888	29.1018	29.1200	29.1925	29.1427	29.0221
	728	32.2284	30.7099	30.6054	30.5397	30.5754	29.5767	29.3541	29.3892	29.5469	29.6370	29.4624	29.5265	29.6409
	182	32.2284	30.0975	30.1510	30.0880	29.9914	29.2027	29.2406	29.1888	29.1018	29.1200	29.1925	29.1427	29.0221
2020.01.01-2020.05.12	364	32.2284	30.7099	30.6054	30.5397	30.5754	29.5767	29.3541	29.3892	29.5469	29.6370	29.4624	29.5265	29.6409
	728	32.2284	30.7099	30.6054	30.5397	30.5754	29.5767	29.3541	29.3892	29.5469	29.6370	29.4624	29.5265	29.6409

Figure 22: RMSE on the consumption forecasts (DK2)

For area DK1 the best performing model is Model C4 with 728 length window, but with slightly worse performance compared to Model C2 (728 w, asinh) for period 2020.01.01-2020.05.12.

Area	Dates	Model 1	C1 728	C2 182	C2 asinh	C2 364	C2 asinh	C2 728	C2 182	C2 asinh	C3 364	C3 asinh	C3 728	C3 182	C3 asinh	C4 182	C4 364	C4 asinh	C4 728	C4 asinh		
DK1	2020.01.01-2020.05.12	C1.728	0.000	6.263	4.549	8.080	8.317	9.848	9.695	4.805	3.425	6.994	6.964	9.300	9.021	4.644	3.340	7.109	6.928	9.557	8.969	
		C2.182	-6.263	0.000	-4.618	0.883	1.444	1.493	1.778	-3.500	-5.233	-0.378	-0.143	1.142	1.166	-2.444	-4.410	0.240	0.153	1.659	1.271	
		C2.182.asinh	-4.549	4.618	0.000	3.759	4.271	3.949	4.210	0.76	-2.136	2.293	2.411	3.454	3.485	1.634	2.710	2.585	3.892	3.506		
		C2.364	-8.083	-3.759	0.000	1.682	1.935	2.236	-2.781	-4.492	-1.949	-1.283	0.812	0.837	-2.307	-3.965	-0.684	-0.701	1.598	0.961		
		C2.364.asinh	-8.317	-1.444	-4.271	-1.682	0.000	0.347	1.329	-3.111	-4.840	-2.497	-2.353	-0.187	-0.057	-2.650	-4.283	-1.352	-1.502	0.584	0.140	
		C2.728	9.848	-1.493	-3.949	-1.935	-0.347	0.000	1.216	-3.085	-4.668	-2.741	-2.169	-0.684	-0.386	-2.666	-4.204	-1.541	-1.522	0.467	-0.116	
		C2.728.asinh	9.695	-1.778	-4.210	-2.236	-1.329	-1.216	0.000	3.259	-4.835	-2.899	-2.693	-1.230	-1.198	-2.858	-4.366	-1.841	-1.971	-0.241	0.786	
		C3.182	-4.805	3.500	-0.780	2.781	3.111	3.085	3.259	0.000	-3.820	1.967	1.977	3.078	3.009	0.191	-2.739	2.440	2.171	3.547	3.068	
		C3.182.asinh	-3.425	5.233	2.136	4.492	4.840	4.668	4.835	3.820	0.000	3.992	4.134	4.134	4.798	2.891	0.163	4.312	4.223	5.168	4.818	
		C3.364	-6.994	0.378	-2.293	1.949	2.497	2.741	2.899	-1.967	-3.992	0.000	5.058	5.163	2.706	-1.523	-3.409	1.392	0.870	2.767	2.669	
		C3.364.asinh	-6.964	0.143	-2.411	1.283	2.351	2.169	2.693	-1.977	-4.134	-0.508	0.000	2.223	2.681	-1.597	-3.542	0.634	0.720	2.911	2.647	
		C3.728	9.300	-1.142	-3.452	-0.812	0.187	0.684	1.230	-3.076	-4.761	-3.163	-2.223	0.000	0.256	-2.589	-4.227	-1.415	-1.376	1.826	0.494	
		C3.728.asinh	9.021	-1.166	-3.455	-0.837	0.057	0.886	1.198	-3.009	-4.798	-2.706	-2.681	-0.256	0.000	-2.572	-4.267	-1.379	-1.629	1.017	0.470	
		C4.182	-6.444	2.444	-0.773	2.307	2.650	2.666	2.858	-0.191	-2.891	1.523	1.597	2.589	2.572	0.000	-3.668	2.413	2.079	3.259	2.783	
		C4.182.asinh	-3.340	4.410	1.634	3.965	4.283	4.204	4.366	2.739	-0.163	3.409	3.542	4.227	4.267	3.668	0.000	4.315	4.183	4.915	4.552	
		C4.364	-7.109	-0.240	-2.710	0.684	1.352	1.541	1.841	-2.440	-4.312	-1.932	-1.934	-0.634	1.415	1.379	-2.413	-4.315	0.000	-0.170	2.763	1.733
		C4.364.asinh	-6.928	-0.153	-2.585	0.701	1.520	1.522	1.971	-2.171	-4.223	-0.870	-0.720	1.376	1.629	-2.079	-4.183	0.170	0.000	2.472	2.152	
		C4.728	9.557	-1.659	-3.892	-1.598	-0.584	0.467	0.241	-3.547	-5.168	-3.787	-2.911	-1.826	-1.017	-3.259	-4.915	-2.763	-2.472	0.000	0.874	
		C4.728.asinh	8.969	-1.271	-3.506	-0.961	-0.140	0.116	0.786	-3.068	-4.818	-2.669	-2.647	-0.494	-0.470	-2.793	-4.552	-1.733	-2.152	0.874	0.000	

Figure 23: Diebold-Mariano Test for consumption forecasts (DK1)

There are different settings for area DK2, but for every period the best model is Model Model C3.

- 2019.01.01-2019.12.31: Model C3, 728 window, None
- 2019.05.13-2020.05.12: Model C3, 364 window, HP
- 2019.01.01-2020.05.12: Model C3, 364 window, HP
- 2020.01.01-2020.05.12: Model C3, 182 window, HP

Area	Dates	Model 1	C2 182	C2 364	C2 728	C2 182	C2 asinh	C2 hp	C3 182	C3 364	C3 728	C3 182	C3 asinh	C3 hp	C3 728	C3 182	C3 asinh	C4 182	C4 364	C4 728	C4 182	C4 asinh	C4 hp	C4 728	C4 asinh
DK2	2020.01.01-2020.05.12	C2.182	0.000	-3.683	-8.047	1.755	-3.697	2.299	-2.740	-3.795	-1.515	-6.175	-6.385	-5.377	1.574	2.052	-2.435	-3.637	-1.278	-6.187	-6.600	-5.576			
		C2.364	3.683	0.000	-10.983	3.988	-0.255	2.489	0.226	1.735	-2.493	-4.683	-3.179	3.858	4.130	0.588	-1.101	1.996	-4.375	-4.974	-3.460				
		C2.728	8.047	10.983	0.000	7.510	3.126	7.717	1.481	3.316	6.090	0.252	-0.258	0.952	7.372	7.555	5.248	3.454	6.277	0.108	-0.660	0.633			
		C3.182	-1.755	-3.988	-7.515	0.000	8.429	1.323	4.389	5.432	-2.989	-7.925	-8.060	-8.636	-0.384	1.158	-0.427	-5.254	-2.712	-7.919	-8.260	-7.030			
		C3.182.asinh	3.697	0.255	-3.126	8.429	0.000	9.040	0.453	-0.724	1.639	3.195	-3.543	-2.467	7.776	8.313	0.724	-0.583	1.845	-3.265	3.813	-2.703			
		C3.182.hp	-2.299	-4.289	-7.717	-1.315	0.000	4.696	5.725	-3.421	-8.122	-8.281	-7.334	-1.936	-0.540	-4.345	-5.554	-3.144	-8.121	-8.479	-7.524				
		C3.364	2.740	-0.228	-4.981	4.389	-0.453	4.690	0.000	-4.310	4.260	-6.698	-8.766	-4.871	4.223	4.499	1.590	3.315	4.323	4.604	-9.025	5.238			
		C3.364.asinh	3.795	1.300	-3.310	5.423	0.724	5.723	4.310	0.000	6.638	5.130	-6.843	-2.976	5.290	5.523	4.480	0.869	0.556	-5.182	-7.132	-3.352			
		C3.728	6.175	4.293	-0.252	7.925	3.195	8.122	8.668	5.130	9.342	0.000	-1.573	1.300	7.757	7.935	8.801	5.233	9.428	-0.613	-2.324	0.712			
		C3.728.asinh	6.385	4.663	0.258	8.060	3.543	8.281	8.766	5.183	9.839	1.573	0.000	2.032	7.883	8.083	8.836	6.795	9.866	0.960	-1.780	1.438			
		C3.728.hp	5.377	3.179	-0.955	6.885	2.467	7.334	4.871	2.971	8.861	-1.300	-2.032	0.000	6.715	7.172	5.190	3.139	8.789	-1.451	-2.543	-1.541			
		C4.182	-1.574	-3.858	-7.378	0.364	-7.776	1.398	-4.223	-5.260	-2.811	-7.783	-6.715	0.000	2.854	-3.971	-5.196	-2.847	-7.845	-8.176	-6.966				
		C4.182.hp	-2.052	-4.130	-7.555	-1.159	8.133	0.540	-4.499	5.523	-3.245	-7.895	-8.083	-7.172	-2.854	0.000	-4.256	-5.465	-3.043	-8.019	-8.388	-7.425			
		C4.364	2.435	-0.586	-5.245	4.027	-0.724	4.346	-1.590	-4.468	2.815	8.801	-8.836	-5.190	3.971	4.256	0.000	-4.686	4.049	4.892	-9.262	-5.591			
		C4.364.asinh	3.637	1.101	0.354	5.254	0.583	5.554	3.315	0.869	5.748	-5.233	-6.795	-3.139	5.196	5.465	4.686	0.000	6.784	-5.447	-7.350	-3.562			
		C4.364.hp	1.278	-1.996	-0.277	2.712	-1.945	3.144	-4.323	-6.556	-1.262	9.426	-9.866	-8.789	2.647	3.043	-4.049	-6.784	0.000	9.617	-10.255	-9.270			
		C4.728	6.187	4.375	-0.108	7.919	3.265	8.121	8.604	5.182	9.368	0.613	-0.960	1.451	7.845	8.019	8.992	5.447	9.617	0.000	-2.419	0.976			
		C4.728.asinh	6.000	4.974	0.660	8.260	3.813	8.479	8.025	7.132	10.111	2.324	1.780	2.543	8.176	8.368	9.262	7.350	10.255	2.419	0.000	2.152			
		C4.728.hp	5.576	3.460	-0.633	7.030	2.703	7.524	5.238	3.352	8.987	-0.712	-1.438	1.541	6.966	7.425	5.591	3.562	9.270	-0.976	-2.152	0.874			

Figure 24: Diebold-Mariano Test for consumption forecasts (DK2)

5.2 Wind power forecasts

The retrieved results from wind power forecasting with standard normalization were significantly better for DK1, and very slightly better for DK2 comparing to the Nord-pool's forecast. Asinh function as normalization was useful only for part of cases with

short calibration window, so I don't consider it as successful results. MAE for Model 4 with 728 window length and for full 2019 year is 6,6% lower, while MAE for last period (2020.01.01-2020.05.12) is 22,19% lower.

Area	Dates	Window	W1	W2 (asinh)	W2 (asinh-hp)	W2 (hp)	W3	W3 (asinh)	W3 (asinh-hp)	W3 (hp)	W4	W4 (asinh)	W4 (asinh-hp)	W4 (hp)		
			182	234.5053	217.4789	215.8943	214.7341	215.6551	219.6931	218.7317	217.7375	218.1050	220.0010	220.0222	218.0514	217.8571
	2019.01.01-2019.12.31		364	234.5053	217.1779	214.9680	210.8029	211.5926	218.82126	216.0995	212.2605	213.0257	218.5291	216.3776	213.2433	213.6965
			728	234.5053	218.8722	217.1265	225.2318	224.0590	219.0693	217.3630	226.1964	224.8970	219.0649	217.3302	227.0352	225.1335
	2019.01.01-2020.05.12		182	283.8955	235.7740	233.8541	232.4461	233.3719	237.8470	237.0606	235.8624	236.1541	238.3007	238.3563	237.1771	236.9041
			364	283.8955	239.1466	236.6201	231.8007	232.9267	240.6124	238.2046	233.6711	234.7300	240.5791	238.0895	234.5342	235.1725
			728	283.8955	248.2129	245.1569	246.4548	246.1251	248.4362	245.3776	247.5864	247.0758	247.8012	248.5268	248.1401	247.2035
DK1			182	304.0500	236.6935	235.3443	232.4261	233.2747	239.2110	238.6459	236.1465	236.2941	240.2263	240.6466	238.4192	237.8396
	2019.05.13-2020.05.12		364	304.0500	243.1853	240.4881	231.3513	232.7017	244.5851	242.0384	233.3375	234.4189	244.5565	241.9797	234.4015	235.0000
			728	304.0500	256.0665	252.4397	242.4979	242.1728	256.1935	252.5289	243.4029	242.7863	255.4059	251.4758	244.1583	242.9778
	2020.01.01-2020.05.12		182	410.4398	284.1102	283.1422	281.0570	281.9934	287.6680	287.3618	285.6044	285.6874	288.5216	288.6716	289.6550	289.1759
			364	410.4398	290.4366	290.0415	289.4264	291.5025	302.0856	298.8966	292.4296	294.2944	301.0921	297.6750	292.9641	294.1102
			728	410.4398	328.7344	322.0822	304.6984	306.6825	329.0299	322.2599	306.2883	307.9427	326.6640	319.1640	306.0596	307.7717

Figure 25: MAE on the wind power forecasts (DK1)

Area	Dates	Window	W1	W2 (asinh)	W2 (asinh-hp)	W2 (hp)	W3	W3 (asinh)	W3 (asinh-hp)	W3 (hp)	W4	W4 (asinh)	W4 (asinh-hp)	W4 (hp)		
			182	64.5167	66.3122	67.0413	67.4307	66.6758	66.8695	67.7520	68.1468	67.1943	67.0683	67.9557	68.2130	67.2834
	2019.01.01-2019.12.31		364	64.5167	65.0329	65.4815	67.8653	67.2296	65.2724	65.8123	68.1706	67.3852	65.1757	65.8565	68.5175	67.5938
			728	64.5167	65.4080	66.0257	74.7557	73.8559	65.5347	65.2718	75.0148	74.0370	65.5368	66.2576	74.7739	73.8716
	2019.01.01-2020.05.12		182	67.2619	69.0686	69.6017	69.8011	69.2103	69.8881	70.5497	70.7663	70.0300	70.0938	70.6660	70.8996	70.2510
			364	67.2619	67.5893	67.9303	69.8319	69.2777	68.0340	68.4954	70.3540	69.6380	68.0403	68.5525	70.6170	69.8619
			728	67.2619	67.4937	67.8985	76.1776	75.3422	67.1115	68.2473	76.3622	75.4676	67.7688	68.2556	76.2949	75.4954
DK2			182	66.8141	69.9545	70.5639	70.9389	70.2817	70.7369	71.4112	71.7878	71.0638	70.7960	71.3476	71.7381	71.0793
	2019.05.13-2020.05.12		364	66.8141	68.1591	68.4344	70.8680	70.2773	68.5159	68.8413	71.0388	70.5430	68.5785	68.8640	71.1720	70.7202
			728	66.8141	67.8917	68.0205	77.0133	76.4850	68.0327	68.2143	77.0524	76.4654	68.0471	68.2089	77.3476	76.7213
	2020.01.01-2020.05.12		182	74.7957	76.6333	76.6285	76.3066	76.1660	78.1720	78.2277	77.9553	77.8123	78.3967	78.1041	78.2726	78.3955
			364	74.7957	74.6069	74.6505	75.2929	74.9895	75.6149	75.8586	76.3462	75.8204	75.9019	75.9513	76.3789	76.0864
			728	74.7957	73.2178	73.0383	80.0800	79.4218	73.6853	73.6990	80.0599	79.3938	73.8943	73.7389	80.4688	79.9520

Figure 26: MAE on the wind power forecasts (DK2)

Area	Dates	Window	W1	W2 (asinh)	W2 (asinh-hp)	W2 (hp)	W3	W3 (asinh)	W3 (asinh-hp)	W3 (hp)	W4	W4 (asinh)	W4 (asinh-hp)	W4 (hp)		
			182	318.3849	290.3546	289.3503	287.5060	288.0211	292.1398	292.1897	290.2684	289.8196	292.8945	294.0494	291.4678	290.2309
	2019.01.01-2019.12.31		364	318.3849	291.0473	288.4411	282.3725	283.6819	291.7512	289.4938	283.0420	284.2917	292.3236	290.1264	284.5274	285.1055
			728	318.3849	292.7880	291.1340	294.6650	294.8072	293.0215	291.2111	294.9754	295.0011	293.0429	291.1902	296.5663	295.5779
	2019.01.01-2020.05.12		182	406.8696	321.3105	319.3540	317.2610	318.7936	323.8967	323.2104	321.1816	321.4703	324.1184	324.3939	322.2900	321.7824
			364	406.8696	330.3779	326.5089	319.1337	321.9901	331.4233	327.5756	320.6410	323.1410	331.7391	326.0553	321.8956	323.6097
			728	406.8696	346.4224	341.3667	333.4185	336.1887	346.3990	341.3394	334.2268	336.6006	345.9703	340.2259	335.1776	337.0265
DK1			182	436.8404	327.2397	325.3969	321.7005	323.0743	329.8075	329.4912	326.0052	325.8949	329.7964	330.6365	327.0491	326.1218
	2019.05.13-2020.05.12		364	436.8404	340.3449	336.0647	324.7154	327.8384	341.2548	337.3300	326.1918	328.7467	341.3650	337.3970	327.4691	329.1208
			728	436.8404	362.4314	356.3375	335.7155	339.1086	362.0436	356.1661	336.0853	338.9054	361.5284	354.8008	337.4553	339.5970
	2020.01.01-2020.05.12		182	584.5163	363.9593	390.0106	387.3483	390.9628	398.2488	398.0497	393.7399	395.5255	397.3669	395.8954	394.6986	395.6478
			364	584.5163	419.7010	412.5762	403.1498	409.0879	421.5320	415.0210	406.3270	411.3181	421.3738	414.6895	407.1943	411.1519
			728	584.5163	462.7041	451.3598	421.8613	429.7469	462.2330	451.1459	423.6569	430.5881	460.9918	448.0228	423.4215	430.7499

Figure 27: RMSE on the wind power forecasts (DK1)

Area	Dates	Window	W1	W2	W2 (asinh)	W2 (asinh-hp)	W2 (hp)	W3	W3 (asinh)	W3 (asinh-hp)	W3 (hp)	W4	W4 (asinh)	W4 (asinh-hp)	W4 (hp)
			182	364	728	182	364	728	182	364	728	182	364	728	182
2019.01.01-2019.12.31	182	89.6924	90.5770	91.3340	91.8347	90.9437	91.0369	92.0400	92.5017	91.3492	91.3910	92.3964	92.8075	91.6583	
		89.6924	89.1968	89.5614	91.9816	91.2586	89.2972	89.7584	92.1715	91.2894	89.2374	89.8611	92.3191	91.3162	
	364	89.6924	90.5253	90.0059	98.7990	97.7557	89.5193	90.0814	98.9810	97.8200	89.4642	90.0298	98.6669	97.6008	
	728	89.6924	93.8419	94.3405	94.7405	94.1276	94.6971	95.4581	95.8298	94.9402	95.1074	95.8076	96.2354	95.3743	
2019.01.01-2020.05.12	182	93.4372	93.8419	94.3405	94.7405	94.1276	94.6971	95.4581	95.8298	94.9402	95.1074	95.8076	96.2354	95.3743	
		93.4372	92.4963	92.6865	94.7561	94.1766	92.8985	93.2715	95.3660	94.5679	92.9781	93.4070	95.5346	94.7055	
	364	93.4372	93.8419	94.3405	94.7405	94.1276	94.6971	95.4581	95.8298	94.9402	95.1074	95.8076	96.2354	95.3743	
	728	93.4372	92.5478	92.7518	100.8334	99.9302	92.7081	93.0374	101.1325	100.1066	92.7592	93.0468	101.0612	100.1567	
2019.05.13-2020.05.12	182	93.6845	94.9894	95.6483	96.3193	95.5403	95.7659	96.6670	97.3150	96.2831	96.0474	96.9053	97.5625	96.5129	
		93.6845	93.4505	93.6273	96.1939	95.6844	93.7752	94.0875	96.6889	96.0140	93.8709	94.1342	96.7499	96.1234	
	364	93.6845	94.9894	95.6483	96.3193	95.5403	95.7659	96.6670	97.3150	96.2831	96.0474	96.9053	97.5625	96.5129	
	728	93.6845	93.7661	93.8217	102.5378	101.8433	93.8442	93.9738	102.7134	101.9201	93.8533	93.9418	102.9080	102.1248	
2020.01.01-2020.05.12	182	103.0172	102.2980	102.1376	102.2918	102.3577	104.0829	104.2645	104.4198	104.1612	104.6304	104.5992	105.0966	104.8981	
		103.0172	100.9649	100.7660	101.9833	101.7556	102.1313	102.2947	103.0281	103.0306	102.5453	102.5102	103.8488	103.4377	
	364	103.0172	100.3761	99.9005	106.2266	105.6682	100.9431	100.7048	106.8146	106.1078	101.2523	100.8641	107.3732	106.8575	
	728	103.0172	100.3761	99.9005	106.2266	105.6682	100.9431	100.7048	106.8146	106.1078	101.2523	100.8641	107.3732	106.8575	

Figure 28: RMSE on the wind power forecasts (DK2)

Forecasts for area DK1 were better in every period with best model W2, 364 window and asinh-hp transformation. Small difference was in the period 2020.01.01-2020.05.12 where best rolling window was 182.

Area	Dates	Model 1	W1	W2 182 asinh-hp	W2 182 hp	W2 364 asinh-hp	W2 364 hp	W2 728 asinh-hp	W2 728 hp	W3 182 asinh-hp	W3 182 hp	W3 364 asinh-hp	W3 364 hp	W3 728 asinh-hp	W3 728 hp	W4 182 asinh-hp	W4 182 hp	W4 364 asinh-hp	W4 364 hp	W4 728 asinh-hp	W4 728 hp
			182	364	728	182	364	728	182	364	728	182	364	728	182	364	728	182	364	728	
DK1	2020.01.01-2020.05.12	W2.182.asinh-hp	0.000	-1.777	-6.592	-7.508	-12.741	-12.843	-5.179	-4.943	-8.337	-9.003	-13.256	-13.319	-6.714	-5.762	-8.484	-8.626	-13.249	-13.300	
		W2.182.hp	1.777	0.000	-6.542	-8.344	-13.390	-13.841	-3.591	-4.712	-8.493	-9.993	-13.959	-14.348	-5.696	-5.501	-8.632	-9.466	-13.829	-14.268	
		W2.364.asinh-hp	6.592	6.542	0.000	-4.130	-15.229	-15.857	2.418	2.640	-4.640	-6.257	-14.681	-15.002	-0.138	-0.146	-4.914	-5.578	-14.101	-14.711	
		W2.364.hp	7.508	8.344	4.130	0.000	-13.256	-15.640	3.544	4.105	-1.212	-4.932	-13.261	-15.475	0.993	1.353	-1.775	-4.034	-12.407	-14.913	
		W2.728.asinh-hp	12.741	13.390	15.229	13.256	0.000	-4.121	9.341	10.224	10.879	9.341	-3.098	-5.049	6.629	7.147	9.981	8.944	-2.368	-4.698	
		W2.728.hp	12.843	13.841	15.057	15.640	4.121	0.000	0.715	10.791	11.419	11.354	0.58	-2.973	7.138	7.793	10.671	10.848	0.812	-2.308	
		W3.182.asinh-hp	5.179	3.591	-2.416	-3.544	-9.341	-9.715	0.000	-0.136	-4.759	-5.607	-10.470	-10.607	-4.071	-2.820	-5.022	-5.355	-10.473	-10.600	
		W3.182.hp	5.148	4.712	-2.640	-4.105	-10.289	-10.791	0.138	0.000	-5.270	-6.746	-11.447	-11.845	-3.488	-3.126	-5.559	-6.388	-11.352	-11.810	
		W3.364.asinh-hp	8.337	8.493	4.640	1.212	-10.879	-11.419	4.759	5.270	0.000	-3.485	-13.483	-13.337	1.633	1.983	-1.805	-2.738	-12.993	-13.134	
		W3.364.hp	9.003	9.993	6.257	4.932	-9.341	-11.954	5.607	6.746	3.405	0.000	-11.940	-13.640	2.610	3.130	2.170	0.587	-10.707	-13.146	
		W3.728.asinh-hp	13.256	13.959	14.681	13.261	3.09	-0.584	10.470	11.434	13.483	11.490	0.000	-3.324	7.478	8.008	12.386	10.923	0.976	-2.988	
		W3.728.hp	13.319	14.348	15.092	15.475	5.049	2.973	10.607	11.845	13.337	13.640	3.224	0.000	7.850	8.530	12.475	12.889	3.094	0.924	
		W4.182.asinh-hp	6.714	5.606	0.133	-0.993	-6.629	-7.163	4.074	3.488	-1.633	-2.610	-7.478	-7.850	0.000	0.738	-1.969	-2.558	-7.324	-7.749	
		W4.182.hp	5.762	5.501	-0.146	-1.353	-7.147	-7.791	2.820	3.126	-1.983	-3.130	-8.008	-8.530	-0.735	0.000	-2.334	-3.118	-7.781	-8.384	
		W4.364.asinh-hp	8.494	8.632	4.914	1.775	-9.981	-10.671	5.022	5.559	1.805	-2.170	-12.386	-12.475	1.969	2.334	0.000	-2.053	-12.018	-12.375	
		W4.364.hp	8.626	9.400	5.576	4.034	-8.944	-10.048	5.355	6.388	2.738	-0.587	-10.923	-12.093	2.558	3.118	2.053	0.000	-10.191	-12.201	
		W4.728.asinh-hp	13.248	13.829	14.101	12.408	2.368	-0.312	10.473	11.352	12.993	10.707	-0.976	-3.094	7.228	7.781	12.018	10.191	0.000	-3.139	
		W4.728.hp	13.300	14.269	14.711	14.913	4.698	2.308	10.600	11.810	13.134	13.146	2.988	-0.024	7.749	8.384	12.375	12.501	3.139	0.000	

Figure 29: Diebold-Mariano Test for wind power forecasts (DK1)

On the other hand best forecast was Nordpool's prognosis in the area DK2, except of period 2020.01.01-2020.05.12 where best model was Model W2, 728 window, asinh.

Area	Dates	Model 1	W2_182	W2_182 asinh- hp	W2_364	W2_364 asinh- hp	W2_728	W2_728 asinh- hp	W3_182	W3_182 asinh- hp	W3_364	W3_364 asinh- hp	W3_728	W3_728 asinh- hp	W4_182	W4_182 asinh- hp	W4_364	W4_364 asinh- hp	W4_728	W4_728 asinh- hp
DK1	2020.01.01-2020.05.12	W2.182.asinh-hp	0.000	-1.777	-6.592	-7.508	-12.741	-12.843	-5.179	-4.943	-8.337	-9.003	-13.259	-13.319	-6.714	-5.762	-8.484	-8.626	-13.248	-13.300
		W2.182.hp	1.777	0.000	-6.542	-8.344	-13.741	-13.841	-3.591	-4.712	-8.493	-9.993	-13.959	-14.348	-6.696	-5.501	-8.632	-9.460	-13.820	14.269
		W2.364.asinh-hp	6.592	6.542	0.000	-4.130	15.229	-15.957	2.415	2.640	-6.460	-8.257	14.802	15.002	-1.139	0.146	-4.914	-5.576	-14.101	14.711
		W2.364.hp	7.504	8.344	4.130	0.000	-13.256	-15.640	3.544	4.105	-1.212	-4.932	-13.948	-15.475	0.993	1.353	-1.775	-4.034	-12.408	14.913
		W2.728.asinh-hp	12.741	13.390	15.229	15.256	0.000	-4.121	9.341	10.224	10.679	9.341	-3.098	-5.049	6.629	7.147	9.981	9.844	-2.368	4.698
		W2.728.hp	12.846	13.841	15.057	15.640	4.121	0.000	9.715	10.791	11.419	11.354	3.584	-2.073	7.163	7.791	10.671	10.848	0.812	-2.308
		W3.182.asinh-hp	5.177	3.591	-2.416	-3.544	-9.341	-9.715	0.000	0.138	-4.759	-5.607	-10.470	-10.607	-4.071	-2.820	-5.022	-5.355	-10.473	-10.600
		W3.182.hp	4.943	4.712	-2.640	-4.105	-10.224	-10.791	0.136	0.000	-5.270	-6.746	-11.433	-11.845	-3.488	-3.126	-5.559	-6.388	-11.352	-11.810
		W3.364.asinh-hp	8.337	8.403	4.640	1.212	-10.879	-11.419	4.759	5.270	0.000	-3.485	-13.449	-13.337	1.633	1.983	-1.805	-2.738	-12.993	-13.134
		W3.364.hp	9.003	9.993	6.257	4.932	-9.341	-11.954	5.607	6.746	3.485	0.000	-11.490	-13.640	2.610	3.130	2.170	0.587	-10.707	13.146
		W3.728.asinh-hp	13.256	13.959	14.681	13.261	3.098	-0.584	10.470	11.433	13.483	11.490	0.000	-3.324	7.478	8.008	12.386	10.923	0.976	-2.988
		W3.728.hp	13.319	14.348	15.002	15.475	5.049	2.973	10.607	11.845	13.337	13.640	3.324	0.000	7.850	8.530	12.475	12.693	3.094	0.924
		W4.182.asinh-hp	6.714	5.696	0.133	-0.993	-6.629	-7.163	4.071	3.488	-1.833	-2.610	-7.478	-7.850	0.000	0.735	-1.969	-2.558	-7.328	-7.749
		W4.182.hp	5.786	5.507	-0.146	-1.353	-7.147	-7.791	2.820	3.126	-1.983	-3.130	-8.004	-8.530	-0.738	0.000	-2.334	-3.118	-7.781	-8.384
		W4.364.asinh-hp	8.484	8.832	4.914	1.775	-9.981	-10.671	5.022	5.559	1.805	-2.170	-12.386	-12.475	1.969	2.334	0.000	-2.053	-12.018	-12.275
		W4.364.hp	8.626	9.460	5.576	4.034	-9.844	-10.948	5.355	6.388	2.738	-0.587	-10.923	-12.893	2.558	3.118	2.053	0.000	-10.191	-12.501
		W4.728.asinh-hp	13.248	13.829	14.101	12.408	2.368	-0.012	10.474	11.352	12.990	10.707	-0.976	-3.094	7.320	7.781	12.018	10.191	0.000	-3.139
		W4.728.hp	13.300	14.289	14.711	14.913	4.698	2.308	10.600	11.810	13.134	13.146	2.988	-0.924	7.749	8.084	12.375	12.501	3.139	0.000

Figure 30: Diebold-Mariano Test for wind power forecasts (DK2)

5.3 Price forecasts

With more complex models results are much better, however *asinh* function surprisingly doesn't improve predictions in the every case. Disproportion is especially big in the last period (2020.01.01-2020.05.12) and Model 4.

I performed Model 5 hoping that with better predictions of wind power and consumption than original ones, price will be more accurate. Because these predictions replaced only values for prediction period, not rolling window, coefficients could be overfitted to the worse values trying to predict using improved ones.

Area	Dates	Window	P1	P1 (asinh)	P2	P2 (asinh)	P2 (hp)	P2 (asinh-hp)	P3	P3 (asinh)	P3 (asinh-hp)	P3 (hp)	P4	P4 (asinh)	P4 (asinh-hp)	P4 (hp)	P5	P5 (asinh)	P5 (asinh-hp)	P5 (hp)	
DK1	2019.01.01-2019.12.31	182	62.419	61.249	50.970	47.9628	47.7381	50.8575	45.5317	42.7631	42.6918	45.4616	41.8227	38.0530	37.9174	41.7375	41.9823	38.2650	38.0872	41.8347	
		364	68.906	67.1030	49.816	47.5152	47.1734	49.4099	43.9993	41.3803	41.2459	43.4320	41.6006	38.0683	37.8144	41.1012	41.8993	38.2523	37.8048	41.1387	
		728	59.616	59.895	48.2713	46.7990	48.2724	49.9277	42.2183	41.2856	42.2936	43.8182	38.5396	36.9538	38.0325	39.7222	38.6369	37.0154	37.6783	39.2963	
		182	74.0371	73.7262	56.3047	52.4223	52.2724	54.1630	47.1442	49.2564	49.1521	47.0493	42.6386	40.1790	42.5200	42.7773	40.4663	40.2625	42.5822		
		364	81.5801	83.1851	53.9097	51.3103	52.8048	53.7330	53.7251	44.5996	44.8034	45.3780	45.4885	40.1258	40.3976	40.0973	40.7431	40.4265	40.4869	40.9187	40.6592
		728	86.4917	87.4418	52.9216	52.9333	49.2518	50.9584	44.9798	43.8384	43.7886	44.9005	39.7074	38.6992	38.8401	39.7202	40.0723	39.9143	39.0015	39.9523	
	2019.05.13-2020.05.12	182	71.8941	72.5523	51.0926	50.9497	50.2518	49.9574	44.9798	44.9005	44.9217	42.3166	41.5878	41.1274	41.4411	43.3380	42.1725	41.4053	42.0401		
		364	83.1402	85.9039	51.9399	52.1965	51.6941	51.4102	44.3334	44.2423	44.0461	42.9127	42.3166	41.5878	41.1274	41.4411	43.3380	42.1725	41.4053	42.0401	
		728	90.3240	91.3046	50.4418	51.3177	50.8952	50.9019	42.7013	43.3715	43.3035	42.4294	38.6668	39.4514	39.3983	38.0728	39.3075	39.8022	39.2594	39.0516	
		182	106.9217	108.0073	63.4542	64.9344	64.7159	63.6245	51.9698	52.1003	51.9040	51.3728	48.8903	46.5069	46.3744	44.6673	46.2144	47.4020	47.1833	45.9378	
		364	121.8626	127.1532	65.1434	68.7022	68.2562	64.6577	51.1346	54.4576	53.8429	50.0724	44.4787	49.8485	49.5082	43.5445	46.4941	51.9619	51.5070	48.1234	
		728	160.2471	163.1103	69.6887	69.9552	68.7187	64.1464	52.1346	54.4576	53.8429	50.0724	44.4787	49.8485	49.5082	43.5445	46.4941	51.2276	50.4598	45.0910	

Figure 31: MAE on the price forecasts (DK1)

Area	Dates	Window	P1	P1 (asinh)	P2	P2 (asinh)	P2 (hp)	P2 (asinh-hp)	P3	P3 (asinh)	P3 (asinh-hp)	P3 (hp)	P4	P4 (asinh)	P4 (asinh-hp)	P4 (hp)	P5	P5 (asinh)	P5 (asinh-hp)	P5 (hp)	
DK2	2019.01.01-2019.12.31	182	60.6858	59.2051	47.1098	43.9585	43.8689	47.0197	42.8005	40.0418	40.0191	42.7953	40.8677	37.6311	37.5928	40.8462	40.9005	37.6356	37.5978	40.8793	
		364	66.6403	65.8945	46.5368	43.7370	43.4099	46.2025	41.8642	39.1297	38.9770	41.6778	37.8993	37.7050	41.6324	41.7530	37.8815	37.6909	41.6208		
		728	57.6415	58.9743	44.8386	42.8476	44.1264	46.0894	40.6209	38.8203	37.7410	41.6559	38.6653	36.5411	37.1855	39.1299	38.6469	36.5323	37.1654	39.1189	
		182	72.0884	71.6346	50.7902	49.0337	48.9657	50.8620	44.9930	42.8715	42.8291	44.5599	42.4264	40.7061	40.6658	42.2127	42.1430	40.7024	40.6546	42.1068	
		364	80.2821	81.0459	50.6433	49.8001	49.2566	50.8038	43.8488	42.6762	42.5482	43.6504	42.0346	41.3187	41.1618	42.8899	42.7796	41.1919	40.9892	42.5584	
		728	84.4036	84.1260	49.7122	49.0534	49.6542	50.2275	42.9932	42.2209	42.7536	43.5251	42.7254	40.0393	40.3770	40.9331	40.4964	39.8414	40.1103	40.5346	
		182	86.7053	89.2609	47.3317	47.0359	46.9511	47.4786	42.3404	41.4531	41.4567	42.3323	38.9638	38.6039	38.6062	38.8649	38.9773	38.5997	38.0029	38.9796	
		364	107.1131	122.8263	61.9195	65.8606	65.3047	61.4044	49.2951	52.4168	52.3527	49.0651	48.4499	50.7027	50.6438	46.2568	46.4197	50.6389	50.5772	46.1935	
		728	157.8496	158.5767	6																

Area	Dates	Window	P1 (asinh)	P1 (hp)	P2 (asinh)	P2 (hp)	P2 (asinh- hp)	P2 (hp)	P3 (asinh)	P3 (hp)	P3 (asinh- hp)	P3 (hp)	P4 (asinh)	P4 (hp)	P4 (asinh- hp)	P4 (hp)	P5 (asinh)	P5 (hp)	P5 (asinh- hp)	P5 (hp)
2019.01.01-2019.12.31	182	85.8074 85.8970	71.0183 69.5550	69.3800 70.8613	64.0467 62.1807	62.0847 63.9167	57.3221 55.4134	55.3484 57.2886	57.3526 55.4122	55.3482 57.3192										
	364	90.9438 90.9558	70.8978 69.1326	68.6577 70.4699	63.1184 60.7418	60.3206 62.7093	58.5958 55.9306	55.5846 58.3923 58.5748	55.9183 56.9119 56.4230	55.2277 55.9161 56.9174										
	728	81.6979 81.8286	68.4909 67.7287	68.0290 70.1321	62.1157 60.2596	60.1666 62.5522	58.4280 55.2235	55.3944 56.9119 56.4230	55.2277 55.9161 56.9174											
	182	97.5207 98.3094	72.8785 72.4752	72.2986 72.7138	64.9670 63.4430	63.3412 64.4372	58.3892 57.7596	57.6712 58.2822 58.3666	57.8722 58.2822 58.3666	57.8079 58.2822 58.3666										
2019.05.01-2020.05.12	182	105.054 106.9854	72.8930 72.3990	72.4667 72.4996	63.9053 63.1275	63.4221 63.7303	59.4980 58.7303	58.4707 59.1991 59.2922	58.6997 58.3870 59.0117											
	728	114.4601 114.6168	72.4238 72.3496	71.9927 72.4006	63.3747 62.6380	62.3413 63.3847	57.8393 58.0554	57.9883 57.9600 57.7600	57.9883 57.9600 57.7600	57.8723 57.9600 57.7600										
	182	81.7205 93.0093	64.4069 65.1309	65.0196 64.8052	58.4133 57.8041	57.7664 58.3409	53.0228 53.5496	53.5471 53.0251 53.0422	53.5520 53.5520	53.5504 53.0418										
	364	103.4034 105.6744	65.2551 66.6613	66.2343 64.7711	57.5874 56.0733	57.8036 57.2014	54.9553 55.0733	54.8478 54.6032 54.8622	55.0473 54.8302 54.5312											
2019.05.13-2020.05.12	728	118.2235 118.0664	65.1960 66.6624	65.5080 65.8200	57.3890 57.4808	57.9015 56.6580	52.9274 53.7103	53.4340 52.2840 52.8748	53.8894 53.4312 52.2605											
	182	124.1372 126.2507	72.7386 72.3990	72.4667 72.4996	63.9053 63.1275	63.4221 63.7303	59.4980 58.7303	58.4707 59.1991 59.2922	58.6997 58.3870 59.0117											
	364	136.4776 140.9881	79.1074 82.4876	82.0164 77.6381	65.6358 69.2530	69.0952 65.3398	61.9820 65.8046	65.7319 61.3899 61.4912	65.7225 65.6697 61.2735											
	728	175.3421 175.5383	79.9217 81.8020	81.8901 78.6005	66.7081 68.7556	67.9527 65.6152	61.5466 65.1980	64.5768 60.7434 61.4133	65.1216 64.5043 60.6200											

Figure 33: RMSE on the price forecasts (DK1)

Area	Dates	Window	P1 (asinh)	P1 (hp)	P2 (asinh)	P2 (hp)	P2 (asinh- hp)	P2 (hp)	P3 (asinh)	P3 (hp)	P3 (asinh- hp)	P3 (hp)	P4 (asinh)	P4 (hp)	P4 (asinh- hp)	P4 (hp)	P5 (asinh)	P5 (hp)	P5 (asinh- hp)	P5 (hp)
2019.01.01-2019.12.31	182	85.8074 85.8970	71.0183 69.5550	69.3800 70.8613	64.0467 62.1807	62.0847 63.9167	57.3221 55.4134	55.3484 57.2886	57.3526 55.4122	55.3482 57.3192										
	364	90.9438 90.9558	70.8978 69.1326	68.6577 70.4699	63.1184 60.7418	60.3206 62.7093	58.5958 55.9306	55.5846 58.3923 58.5748	55.9183 56.9119 56.4230	55.2277 55.9161 56.9174										
	728	81.6979 81.8286	68.4909 67.7287	68.0290 70.1321	62.1157 60.2596	60.1666 62.5522	58.4280 55.2235	55.3944 56.9119 56.4230	55.2277 55.9161 56.9174											
	182	97.5207 98.3094	72.8785 72.4752	72.2986 72.7138	64.9670 63.4430	63.3412 64.4372	58.3892 57.7596	57.6712 58.2822 58.3666	57.8722 58.2822 58.3666	57.8079 58.2822 58.3666										
2019.05.13-2020.05.12	182	105.054 106.9854	72.8930 72.3990	72.4667 72.4996	63.9053 63.1275	63.4221 63.7303	59.4980 58.7303	58.4707 59.1991 59.2922	58.6997 58.3870 59.0117											
	364	108.054 106.9854	72.8930 72.3990	72.4667 72.4996	63.9053 63.1275	63.4221 63.7303	59.4980 58.7303	58.4707 59.1991 59.2922	58.6997 58.3870 59.0117											
	728	114.4601 114.6168	72.4238 72.3496	71.9927 72.4006	63.3747 62.6380	62.3413 63.3847	57.8393 58.0554	57.9883 57.9600 57.7600	57.9883 57.9600 57.7600	57.8723 57.9600 57.7600										
	182	91.7205 93.0093	64.4069 65.1309	65.0196 64.8052	58.4133 57.8041	57.7664 58.3409	53.0228 53.5496	53.5471 53.0251 53.0422	53.5520 53.5520	53.5504 53.0418										
2019.05.13-2020.05.12	364	103.4034 105.6744	65.2551 66.6613	66.2343 64.7711	57.5874 56.0733	57.8036 57.2014	54.9553 55.0733	55.0703 54.8478 54.6032	54.8622 55.0473 54.5312											
	728	118.2235 118.0664	65.1960 66.6624	65.5080 65.8200	57.3890 57.4808	57.9015 56.6580	52.9274 53.7103	53.4340 52.2840 52.8748	53.8894 53.4312 52.2605											
	182	124.1372 126.2507	72.7386 72.3990	72.4667 72.4996	63.9053 63.1275	63.4221 63.7303	59.4980 58.7303	58.4707 59.1991 59.2922	58.6997 58.3870 59.0117											
	364	136.4776 140.9881	79.1074 82.4876	82.0164 77.6381	65.6358 69.2530	69.0952 65.3398	61.5620 65.8046	65.7319 61.3899 61.4912	65.7225 65.6697 61.2735											
2020.01.01-2020.05.12	728	175.3421 175.5383	79.9217 81.8020	81.8901 78.6005	66.7081 68.7556	67.9527 65.6152	61.5466 65.1980	64.5768 60.7434 61.4133	65.1216 64.5043 60.6200											

Figure 34: RMSE on the price forecasts (DK2)

Best performing models for area DK1 were differential and Model P5 was best only in one period. In some settings there was no significant difference between models P5 and P4. IN the both areas best length of rolling window was 728.

- 2019.01.01-2019.12.31: Model P4, 728 window, Asinh
- 2019.05.13-2020.05.12: Model P5, 728 window, HP
- 2019.01.01-2020.05.12: Model P4, 728 window, None
- 2020.01.01-2020.05.12: Model P4, 728 window, HP

Area	Dates	Model 1	P4 182 asinh	P4 182 hp	P4 364 asinh	P4 364 hp	P4 728 asinh	P4 728 hp	P4 728 asinh- hp	P4 728 hp	P5 182 asinh	P5 182 hp	P5 364 asinh	P5 364 hp	P5 728 asinh	P5 728 hp	P5 728 asinh- hp	P5 728 hp			
DK1	2020.01.01-2020.05.12	P4.182	0.000 -5.871 -5.401	10.142	-12.859	-12.506	-5.698	1.053	-9.402	-8.576	3.635	-12.900	-8.840	-8.099	10.096	-4.812	-12.438	-10.936	-0.717		
		P4.182.asinh	5.871	0.000	6.768	6.481	-12.737	-12.288	0.466	5.140	-7.737	-6.700	7.355	0.974	-9.060	-6.924	1.883	0.060	-11.677	-9.721	3.712
		P4.182.asinh-hp	5.401	-6.768	0.000	-13.001	-12.597	0.076	-7.778	-7.999	-6.977	5.036	0.532	-9.980	-6.220	1.447	-0.285	-11.888	-9.961	3.348	
		P4.182.hp	-10.142	-6.481	-6.031	-13.001	-12.597	-0.076	-7.778	-7.999	-6.977	5.036	0.532	-9.980	-6.220	1.447	-0.285	-11.888	-9.961	3.348	
	2019.01.01-2019.12.31	P4.364	12.859	12.737	13.001	13.165	0.000	6.630	12.453	13.881	2.203	2.919	15.401	9.621	9.708	10.286	10.138	10.115	-2.047	0.604	
		P4.364.asinh	12.859	12.737	13.001	13.165	0.000	6.630	12.453	13.881	2.203	2.919	15.401	9.620	9.707	10.285	10.137	10.115	-2.047	0.604	
		P4.364.asinh-hp	12.859	12.737	13.001	13.165	0.000	6.630	12.453	13.881	2.203	2.919	15.401	9.620	9.707	10.285	10.137	10.115	-2.047	0.604	
		P4.364.hp	5.698	-0.466	-0.768	-12.453	-11.878	0.000	6.103	-13.419	-12.725	-8.390	3.113	14.021	-9.421	-8.714	-12.146	-5.291	-12.712	-11.234	-1.253
	2019.05.13-2020.05.12	P4.728	-1.053	-5.140	-4.778	-13.881	-13.450	-6.103	-14.767	-15.432	-14.565	0.000	-6.757	-9.111	-8.578	-6.039	-15.828	-18.470	-17.225	-11.017	
		P4.728.asinh	9.402	7.737	7.999	9.711	-2.203	-6.180	7.225	13.419	0.000	4.031	0.000	14.556	5.763	4.346	4.793	6.254	6.846	-7.831	0.000
		P4.728.asinh-hp	8.976	6.700	8.890	-2.919	-2.400	6.303	12.271	-4.031	0.000	14.556	5.763	4.346</td							

In the area DK2 best performing model was Model P5 in every period, however again in some settings there was no big difference compared to the Model P4.

- 2019.01.01-2019.12.31: Model P5, 728 window, Asinh
- 2019.05.13-2020.05.12: Model P5, 728 window, HP
- 2019.01.01-2020.05.12: Model P5, 728 window, Asinh
- 2020.01.01-2020.05.12: Model P5, 728 window, HP

Area	Dates	Model 1	P4_182 asinh	P4_182 asinh- hp	P4_182 hp	P4_364 asinh	P4_364 asinh- hp	P4_728 asinh	P4_728 asinh- hp	P4_728 hp	P5_182 asinh	P5_182 asinh- hp	P5_364 asinh	P5_364 asinh- hp	P5_728 asinh	P5_728 asinh- hp	P5_728 hp						
DK2	2020.01.01-2020.05.12	P4.182	0.000	-10.694	-10.520	4.671	-1.651	-10.221	-10.105	-0.965	-6.734	-5.995	0.711	4.100	-10.563	-10.405	5.658	-9.972	-0.709	-6.613	-5.888	0.954	
		P4.182.asinh	10.694	0.000	3.714	10.839	7.346	-4.761	-4.601	6.429	-0.944	0.024	7.959	10.936	1.826	3.572	10.905	-4.420	6.688	-0.791	0.157	8.202	
		P4.182.asinh-hp	10.520	-3.714	0.000	10.674	7.237	-4.921	-4.766	6.333	-1.056	-0.089	7.871	10.762	-0.659	1.645	10.905	-4.595	6.592	-0.902	0.044	8.113	
		P4.182.hp	-4.671	-10.839	-10.674	0.000	-1.802	-10.312	-10.200	-1.089	-6.819	-6.080	0.959	1.76	-10.707	-10.599	4.002	-10.066	0.824	-6.694	-5.971	0.843	
		P4.364	1.651	-7.344	-7.237	1.802	0.000	-12.905	-12.670	0.380	-6.74	-5.828	1.908	-7.202	-7.106	2.045	-12.449	0.725	-6.588	-5.690	2.806		
		P4.364.asinh	10.221	4.760	4.921	10.312	12.905	0.000	2.767	0.000	10.322	3.384	4.530	11.659	10.217	4.847	4.800	10.305	4.048	10.587	3.548	4.664	11.896
		P4.364.asinh-hp	10.105	4.601	4.766	10.200	12.670	-2.767	0.000	10.322	3.384	4.530	10.311	4.805	4.953	10.415	4.799	10.699	3.723	4.816	11.972		
		P4.728	0.965	-6.424	-6.333	1.800	-0.380	-10.431	-10.322	0.000	-8.401	-7.410	13.938	1.167	-6.315	-6.230	1.273	-10.139	7.563	-8.252	-7.214	14.711	
		P4.728.asinh	6.738	0.944	1.084	6.819	6.748	-3.560	-3.384	8.481	0.000	8.020	10.109	6.857	1.015	1.117	6.932	-3.190	8.783	3.528	8.499	10.387	
		P4.728.asinh-hp	5.998	-0.024	0.889	6.080	5.826	-4.683	-4.530	7.410	-8.000	9.138	6.122	0.054	0.157	6.199	-4.341	7.710	-6.467	3.071	9.419		
		P4.728.hp	-0.711	-7.859	-7.871	-0.599	-2.495	-11.730	-11.655	-13.528	-10.109	-9.139	0.000	-0.498	-7.840	-7.762	-0.386	-11.473	-11.234	-9.875	-8.933	7.028	
		P5.182	-4.100	-10.936	-10.762	-1.760	-1.908	-10.331	-10.217	-1.167	-6.857	-6.122	0.488	0.000	-10.842	-10.682	4.256	-10.099	0.915	-6.735	-6.616	0.728	
		P5.182.asinh	10.563	-1.826	0.659	10.707	7.202	-4.805	-4.647	6.310	-1.051	-0.094	7.849	10.842	0.000	3.409	10.974	-4.473	6.571	-0.863	0.079	8.083	
		P5.182.asinh-hp	10.405	-3.572	-1.645	10.558	7.106	-4.953	-4.800	6.230	-1.117	-0.157	7.762	10.682	-3.409	0.000	10.823	-4.626	6.489	-0.966	-0.024	8.005	
		P5.182.hp	-5.658	-11.070	-10.999	-4.002	-2.045	-10.415	-10.305	-1.273	-6.932	-6.199	0.396	-4.256	-10.874	-10.823	0.000	-10.178	-1.021	-8.810	-8.093	0.826	
		P5.364	0.972	4.420	4.58	10.084	12.449	-4.795	-4.048	10.136	3.190	4.34	11.474	10.899	4.473	4.625	10.178	0.000	10.408	3.361	4.484	11.722	
		P5.364.asinh	6.738	-6.688	-6.592	0.824	-0.725	-10.696	-10.587	-7.563	-8.763	-7.710	11.234	0.915	-6.574	-6.489	1.021	-10.409	0.000	-8.561	-7.519	13.436	
		P5.364.asinh-hp	6.613	0.761	0.903	6.694	6.588	-3.723	-3.548	0.252	-3.528	-6.647	9.875	6.735	0.883	0.966	6.810	-3.361	8.561	0.000	7.883	10.162	
		P5.728	5.888	-0.157	-0.044	5.971	5.690	-4.816	-4.664	7.214	-8.409	3.071	8.933	6.016	-0.079	0.024	6.093	-4.484	7.519	-7.883	0.000	9.221	
		P5.728.asinh	-0.954	8.202	-8.113	-0.843	-2.806	-11.972	-11.898	-14.721	-10.387	-9.419	-7.028	-9.728	-8.083	-8.005	-0.628	-11.722	-13.436	10.182	-9.221	0.000	

Figure 36: Diebold-Mariano Test for price forecasts (DK2)

6 Conclusions

Almost all of the assumptions came true, forecasts for consumption and partially for wind power have been performed better than original prepared by Nordpool. Even models for wind power performed well however it is not typical time-series problem, because more important factors influencing such as atmospheric models were not known and not used in this work.

Main finding is that period of forecast matters in using the most efficient model. For some periods more accurate were shorter calibration windows, because anomalies in the 2020 caused by COVID-19 changed seasonal trends like consumption and thus price which was significantly lower in 2020 than 2019.

One assumption I found invalid was that *asinh* normalization function improves price predictions. It does but not for 2020 year where *asinh* and *asinh-hp* normalization fails with every length of calibration window. It also fails for wind power DK2 where power production is probably too low to have impact on the seasonal trend, thus mostly best forecast is provided by Nordpool. In the area DK1 best forecasts used *asinh-hp*

transformation and no other forecasts and areas used this transformation as the best one. Other used either asinh or hp filter. not both.

Experiment of replacing original forecasts of Nordpool with better, forecasted results unfortunately failed but I still see potential with bigger calibration window, which can be used to trained better forecasts for whole considering period of price prediction. But for this purpose it's necessary to have more data. However for DK2 Model P5 has better performance, this model uses original wind power forecast so it's not know very different from Model P4.

There are still some questions that should be resolved to receive better forecasts and I think the biggest one is to find relation between area DK1 and DK2, because for now there is no one universal model for both areas. Knowing this relation should get profits in predicting more accurate prices for electricity.

7 Appendix

7.1 Diebolt-Mariano test results

7.1.1 Consumption forecasts

Area	Dates	Model 1	C1 728	C2 182	C2 asinh	C2 364	C2 asinh	C2 728	C2 182	C2 asinh	C3 182	C3 364	C3 asinh	C3 728	C3 182	C3 asinh	C4 182	C4 364	C4 asinh	C4 728	C4 asinh
		C1.728	0.000	12.212	-3.854	16.451	17.436	21.301	20.259	9.083	6.689	17.346	16.021	21.230	19.950	8.198	5.660	16.796	15.393	71.452	10.011
		C2.182	-12.212	0.000	-5.278	6.492	5.191	7.179	6.097	-5.577	-8.438	5.341	3.794	7.608	6.343	-6.116	-9.235	4.741	3.132	7.915	6.500
		C2.182.asinh	-9.854	5.278	0.000	8.285	7.607	8.882	8.202	-1.111	-5.938	7.216	6.102	9.213	8.342	-2.141	-6.983	6.704	5.476	9.506	8.506
		C2.364	-18.451	-6.492	-8.285	2.659	4.065	-8.659	-10.665	-0.729	-2.619	3.465	1.396	-9.013	-11.317	-1.255	-3.090	4.018	1.739		
		C2.364.asinh	-17.436	-8.191	-7.607	2.631	0.000	3.787	2.376	-7.635	-10.669	0.814	-1.394	4.352	2.793	-8.100	-10.774	0.170	-2.035	4.837	3.086
		C2.728	-21.381	-7.179	-3.882	-2.659	-3.787	0.000	-3.458	-9.251	-11.191	-2.295	-3.736	2.188	-0.471	-9.976	-11.819	-2.591	-4.090	2.930	0.665
		C2.728.asinh	-20.269	-6.097	-8.202	-0.465	-2.376	3.458	0.000	-8.370	-10.983	-0.982	-2.656	3.733	1.520	-8.792	-11.263	-1.287	-3.102	4.272	1.927
		C3.182	-9.063	5.577	1.111	8.655	7.635	9.251	8.379	0.000	-5.800	9.486	7.738	10.662	9.546	-2.646	-6.981	8.736	6.930	10.917	9.644
		C3.182.asinh	-6.689	8.438	5.938	10.655	10.059	11.191	10.583	5.800	0.000	11.290	10.490	12.381	11.764	3.318	-3.497	10.691	9.713	12.641	11.884
DK1	2019.01.01-2019.12.31	C3.364	-17.346	-8.341	-7.216	0.72	-0.814	2.295	0.862	-9.498	-11.290	0.000	-3.411	4.616	2.247	-9.784	-11.900	-1.213	-3.680	5.140	2.571
		C3.364.asinh	-16.021	-3.794	-6.102	2.619	1.38	3.736	2.656	-7.738	-10.406	3.411	0.000	5.772	4.614	-8.134	-11.158	1.872	-1.645	6.211	4.807
		C3.728	-21.292	-7.608	-3.213	-3.465	-4.352	-2.188	-3.733	-10.662	-12.881	-4.616	-5.772	0.000	-3.690	-10.894	-12.922	-4.562	-5.903	2.053	-2.240
		C3.728.asinh	-19.954	-6.343	-8.342	-1.396	-2.793	0.471	-1.528	-9.546	-11.764	-2.247	-4.614	3.690	0.000	-9.878	-12.371	-2.571	-4.831	4.202	1.211
		C4.182	-8.196	6.116	2.141	9.011	8.100	9.576	8.792	2.646	-3.318	9.731	8.191	10.869	9.876	0.000	-6.208	9.796	7.935	11.497	10.266
		C4.182.asinh	-5.660	9.239	6.983	11.317	10.774	11.819	11.263	6.881	3.497	11.900	11.158	12.932	12.371	6.208	0.000	11.951	11.080	13.517	12.883
		C4.364	-16.786	-4.741	-6.704	1.256	-0.170	2.591	1.287	-8.736	-10.691	1.213	-1.872	4.562	2.571	-9.784	-11.951	0.000	-3.676	5.846	3.186
		C4.364.asinh	-15.382	-3.132	-3.470	3.099	2.03	4.090	3.102	-6.939	-9.713	3.680	1.645	5.903	4.831	-7.958	-11.083	3.678	0.000	6.967	5.716
		C4.728	-21.452	-7.915	-3.956	-4.013	-4.837	-2.930	-4.272	-10.917	-12.641	-5.140	-6.211	-2.053	-4.202	-11.497	-13.517	-5.848	-6.967	0.000	-4.119
		C4.728.asinh	-20.011	-6.500	-3.500	-1.739	-3.00	-0.095	-1.927	-9.644	-11.894	-2.571	-4.807	2.240	-1.211	-10.242	-12.833	-3.186	-5.716	4.119	0.000

Figure 37: Diebold-Mariano Test for consumption forecasts (DK1)

Area	Dates	Model 1	C1 728	C2 182	C2 asinh	C2 364	C2 asinh	C2 728	C2 182	C2 asinh	C3 182	C3 364	C3 asinh	C3 728	C3 182	C3 asinh	C4 182	C4 364	C4 asinh	C4 728	C4 182	C4 asinh
		CL1.728	0.000	10.844	8.922	16.192	15.679	19.205	19.494	8.200	6.362	14.976	14.213	19.802	18.010	7.515	5.690	14.846	13.933	19.198	18.057	
		CL2.182	-10.844	0.000	4.888	5.289	4.640	5.798	5.438	-0.121	-7.276	3.771	2.946	5.746	5.227	4.934	-7.337	4.057	2.964	6.497	5.479	
		C2.182.asinh	-8.922	4.898	0.000	7.509	7.348	7.865	7.748	-0.843	-4.740	5.944	5.382	7.652	7.347	-1.408	-4.986	6.134	5.316	8.316	7.562	
		C2.364	-16.192	-5.289	7.509	0.000	-0.493	3.182	2.346	-7.360	-9.088	-1.384	-1.980	2.754	1.933	7.151	-9.072	-0.393	-1.506	3.913	2.324	
		C2.364.asinh	-15.679	-4.640	7.348	0.404	0.000	2.832	3.051	-6.826	-8.860	-0.887	-1.890	2.638	2.256	6.728	-8.852	-0.111	-1.355	3.684	2.620	
		C2.728	-19.205	-5.798	7.865	-3.182	-2.832	0.000	-0.361	-7.785	-9.465	-3.086	-3.453	0.706	-0.052	7.612	-9.466	-2.022	-2.876	2.319	0.559	
		C2.728.asinh	-19.494	-5.438	7.749	-2.346	-3.051	0.361	0.000	-7.459	-9.290	-2.617	-3.399	0.764	0.173	7.355	-9.305	-1.733	-2.798	2.117	0.794	
		C3.182	-8.200	5.121	0.843	7.360	6.828	7.785	7.458	0.000	-4.705	7.725	6.570	8.713	8.180	1.321	-4.840	7.781	6.405	9.373	8.383	
		C3.182.asinh	-6.362	7.271	4.740	9.088	8.860	9.465	9.290	4.706	0.000	9.686	9.085	10.318	10.172	2.799	-1.737	9.509	8.854	10.917	10.333	
DK1	2019.05.13-2020.05.12	CL3.64	-14.976	-3.771	-5.944	1.384	0.867	3.086	2.617	-7.725	-9.466	0.000	-1.417	4.727	3.468	7.307	-9.292	1.223	-0.739	5.870	3.780	
		C3.64.asinh	-14.219	-2.946	5.382	1.98	1.890	3.453	3.399	-6.570	-9.06	1.417	0.000	4.684	4.793	4.813	-8.931	1.895	0.406	5.728	5.024	
		C3.728	-18.802	-5.746	7.652	-2.754	-2.635	-0.706	-0.764	-8.713	-10.318	-4.727	-4.684	0.000	-0.991	8.859	10.189	-2.923	-3.737	3.264	0.682	
		C3.728.asinh	-18.010	-5.227	7.347	-1.933	-2.256	0.052	-0.173	-8.180	10.172	-3.488	-4.793	0.991	0.000	7.942	10.055	-2.197	-3.650	2.848	1.375	
		C4.182	-7.515	4.934	1.408	7.151	6.728	7.612	7.359	1.321	-2.799	7.307	6.413	8.359	7.942	0.000	-4.758	8.555	7.031	9.498	8.401	
		C4.182.asinh	-5.690	7.337	4.968	9.072	8.852	9.466	9.365	4.840	1.737	9.592	8.931	10.181	10.055	4.759	0.000	10.312	9.616	11.250	10.973	
		C4.364	-14.804	-4.057	-6.134	0.393	0.111	2.022	1.733	-7.781	-9.509	-1.223	-1.895	2.923	2.197	8.855	10.312	0.000	-2.113	5.013	2.962	
		C4.364.asinh	-13.933	-2.954	5.316	1.506	1.355	2.876	2.798	-6.405	-8.854	-0.739	-0.406	3.737	3.650	7.031	-9.678	2.113	0.000	5.489	4.772	
		C4.728	-19.188	-6.497	-8.316	-3.913	-3.684	-2.319	-2.117	-9.373	-10.917	-5.870	-5.728	-3.264	-2.848	9.498	11.250	-5.013	-5.489	0.000	-2.388	
		C4.728.asinh	-18.057	-5.479	7.562	-2.324	-2.620	-0.559	-0.794	-8.353	10.333	-3.780	-5.024	-0.082	-1.375	8.491	10.673	-2.962	-4.772	2.388	0.000	

Figure 38: Diebold-Mariano Test for consumption forecasts (DK1)

Area	Dates	Model 1	C1 728	C2 182	C2 asinh	C2 364	C2 asinh	C2 728	C2 182	C2 asinh	C3 182	C3 364	C3 asinh	C3 728	C3 182	C3 asinh	C4 182	C4 364	C4 asinh	C4 728	C4 182	C4 asinh
		CL1.728	0.000	13.508	10.634	19.605	18.935	23.068	22.014	10.158	7.425	18.074	17.003	22.679	21.409	9.340	6.538	17.648	16.441	22.535	21.399	
		CL2.182	-13.508	0.000	5.778	4.987	6.492	5.775	-4.584	-9.920	4.094	5.238	9.938	8.635	5.630	-6.399	-10.078	3.956	2.590	7.217	5.818	
		C2.182.asinh	-10.634	7.002	0.000	8.966	8.671	9.474	9.051	-0.465	-6.04	7.220	6.352	9.420	8.696	-1.254	-6.544	7.024	5.936	9.919	8.843	
		C2.364	-19.605	-5.778	-8.966	0.000	-0.951	3.289	1.790	-8.703	-11.329	-1.973	-2.845	3.220	2.161	-6.831	-11.499	-1.393	-2.815	4.118	1.949	
		C2.364.asinh	-18.935	-4.987	-6.871	0.951	0.000	3.282	2.703	-8.005	-10.280	-2.787	-2.578	2.391	2.159	-8.032	-11.179	-0.774	-2.531	4.106	2.456	
		C2.728	-23.068	-6.492	-8.775	3.289	-3.262	0.000	-1.595	-9.230	-11.778	-4.498	-4.283	1.196	-0.608	-9.353	-11.944	-2.970	-4.127	2.457	-0.030	
		C2.728.asinh	-22.014	-5.775	-8.081	1.790	-2.703	1.595	0.000	-5.990	-11.339	-2.535	-3.760	1.860	0.322	-8.603	-11.355	-2.190	-3.637	2.872	0.833	
		C3.182	-10.158	6.584	0.465	8.703	8.005	9.230	8.890	0.000	-6.842	8.919	7.419	10.381	9.390	-1.721	-7.122	8.526	6.886	10.868	9.494	
		C3.182.asinh	-7.425	9.920	0.082	11.324	10.994	11.778	11.339	6.942	0.000	11.610	10.972	12.838	12.313	4.391	-2.491	11.252	10.367	13.276	12.404	
		C3.364	-18.074	-4.094	-7.220	1.793	0.971	3.498	2.535	-8.919	-11.610	0.000	-2.327	5.593	3.451	-8.634	-11.669	0.134	-2.155	6.381	3.687	
		C3.364.asinh	-17.003	-2.938	-4.352	2.845	2.578	4.283	3.760	-7.419	-10.972	-2.327	0.000	5.974	5.307	-7.433	-11.075	1.798	-6.668	6.710	5.425	
		C3.728	-22.679	-6.835	-9.420	3.220	-3.291	-1.196	-1.860	-10.381	-12.838	-5.593	-5.974	0.000	-2.548	10.122	-12.884	-4.376	-5.454	2.738	1.256	
		C3.728.asinh	-21.409	-5.630	-6.696	1.611	-2.153	0.608	-0.322	-0.990	-12.313	-3.451	-3.307	2.548	0.000	-9.235	-12.406	-2.822	-4.771	3.730	1.182	
		C4.182	-9.340	6.399	1.254	8.614	8.032	9.153	8.603	1.721	-4.396	8.666	8.476	10.122	9.281	0.000	-7.191	9.455	7.649	11.132	9.774	
		C4.182.asinh	-6.538	10.078	0.544	11.499	11.179	11.944	11.535	7.122	2.491	11.669	11.075	12.884	12.408	7.191	0.000	12.339	11.488	13.833	12.985	
		C4.364	-17.648	-3.956	-7.024	1.393	0.774	2.970	2.190	-8.526	-11.252	-0.134	-1.798	4.376	2.832	-9.455	-12.339	0.000	-2.929	6.318	3.543	
		C4.364.asinh	-16.441	-2.590	-5.936	2.815	2.531	4.127	3.637	-8.686	-10.367	2.155	0.668	5.454	4.771	-7.649	-11.485	2.929	0.000	7.073	5.855	
		C4.728	-22.905	-7.217	-9.919	-4.118	-4.106	-2.457	-2.872	-10.869	-12.376	-6.381	-6.710	-2.738	-3.739	-11.132	-13.833	-6.318	-7.073	0.000	-3.604	
		C4.728.asinh	-21.399	-5.818	4.843	1.949	-2.456	0.030	-0.833	-0.944	-12.404	-3.687	-5.425	1.256	-1.382	-9.774	-12.985	-3.543	-5.855	3.604	0.000	

Figure 40: Diebold-Mariano Test for consumption forecasts (DK1)

Area	Dates	Model 1	C1 728	C2 182	C2 asinh	C2 364	C2 asinh	C2 728	C2 182	C2 asinh	C3 182	C3 364	C3 asinh	C3 728	C3 182	C3 asinh	C4 182	C4 364	C4 asinh	C4 728	C4 182	C4 asinh
		CL1.728	0.000	6.263	4.549	8.080	8.317	9.848	9.695	4.805	3.425	6.994	6.964	9.300	9.021	4.644	3.340	7.019	6.928	9.557	9.869	
		CL2.182	-6.263	0.000	-6.418	0.883	1.444	1.493	1.778	-3.500	-5.233	-0.378	-0.143	1.142	1.166	-2.444	-4.410	0.240	0.153	1.659	1.271	
		C2.182.asinh	-4.549	4.618	0.000	3.759	4.271	3.949	4.210	0.780	-2.136	2.293	2.411	3.452	3.455	0.773	-1.634	2.710	2.585	3.892	3.506	
		C2.364	-8.080	-0.883	-4.799	0.000	1.682	1.935	2.336	2.761	-4.492</											

Area	Dates	Model 1	C2 182	C2 364	C2 728	C3 182	C3 364	C3 728	C3 asinh	C3 hp	C3 364	C3 728	C3 asinh	C3 hp	C4 182	C4 364	C4 728	C4 asinh	C4 hp			
DK2	2019.01.01-2019.12.31	C2.182	0.000	9.770	10.352	3.804	-4.708	4.113	8.435	5.173	7.792	11.176	9.285	5.608	2.334	2.573	6.632	3.272	5.827	9.359	7.281	4.219
		C2.364	-9.770	0.000	3.685	-3.330	-9.840	-3.062	2.202	-1.027	1.546	5.189	3.081	-0.839	-4.387	-4.180	0.272	-2.978	-0.562	3.107	0.885	-2.288
		C2.728	-10.352	3.685	0.000	4.528	-10.581	-4.291	0.385	-2.441	-0.168	3.591	1.364	-2.814	-5.492	-5.310	-1.318	-4.226	-2.090	1.346	-0.914	-4.347
		C3.182	-3.804	3.330	4.528	0.000	-13.681	2.772	7.750	3.121	6.457	9.243	7.332	2.734	-5.152	-3.856	5.103	0.472	3.756	7.198	4.951	1.266
		C3.182.asinh	4.708	9.840	10.591	13.691	0.000	13.991	1/1.699	11.833	13.585	15.451	14.462	9.673	11.157	11.388	12.675	9.377	11.489	13.752	12.396	8.360
		C3.182.hp	-4.113	3.062	4.271	-2.772	-13.991	0.000	7.311	2.754	0.265	9.927	7.029	2.535	-5.867	-5.359	4.695	0.129	3.488	8.778	4.649	1.017
		C3.278	-8.435	2.202	3.895	-7.750	-14.639	-7.311	0.000	-7.379	-1.832	4.343	1.237	-3.715	-8.977	-8.624	-6.391	-10.060	-6.371	1.194	-5.473	
		C3.364	-5.173	1.027	2.446	-3.121	-11.833	2.754	7.379	0.000	5.096	0.046	6.979	2.871	-4.531	-4.224	2.688	-6.594	0.909	3.391	3.170	-1.414
		C3.364.hp	-7.792	-1.546	0.184	-6.457	-13.585	-6.265	1.832	-5.096	0.000	4.999	2.027	-3.820	-7.713	-7.616	-2.934	-7.976	-7.330	2.04	-0.996	-5.961
		C3.728	-11.176	5.181	-3.591	-9.243	-15.451	-6.927	-4.343	-8.046	-4.990	0.000	-4.788	9.956	10.248	-10.002	-6.868	-10.270	-7.788	-7.04	-4.856	11.867
		C3.728.asinh	9.285	3.081	-1.394	-7.332	-14.082	-7.029	-1.327	-6.978	-2.207	4.789	0.000	-4.245	-8.434	-8.202	-4.003	-9.423	-5.148	-0.216	-7.669	-8.281
		C3.728.hp	-5.606	0.833	2.814	-2.734	-9.673	-2.335	3.715	-0.287	3.820	9.956	6.245	0.000	-3.870	-3.767	1.324	-2.633	0.398	6.307	2.634	-6.400
		C4.182	-2.334	4.389	5.492	5.152	-11.157	5.867	8.977	4.516	7.715	10.248	8.434	3.870	0.000	2.220	6.764	1.884	5.323	8.318	6.164	2.445
		C4.182.hp	2.573	4.180	5.310	3.856	-11.988	5.359	8.624	4.224	7.610	10.022	8.022	3.767	-2.220	0.000	6.416	1.702	5.165	8.079	5.933	2.296
		C4.364	-6.682	-0.272	1.318	-5.103	-12.675	-6.495	3.391	-2.688	2.934	5.868	4.003	-1.324	-6.764	-5.618	0.000	-8.097	-2.659	4.227	0.915	-3.176
		C4.364.asinh	-3.272	2.978	4.226	-0.472	-9.129	10.129	10.060	6.594	7.976	10.270	9.423	2.633	-1.984	-1.702	0.007	5.238	8.307	6.669	1.020	
		C4.364.hp	-5.827	0.562	2.090	-3.756	-11.489	-3.488	6.371	-0.909	7.330	7.788	5.146	-0.398	-5.323	-5.165	2.659	-5.238	0.000	5.318	2.163	-2.687
		C4.728	-9.359	-3.107	-1.348	-7.186	-13.752	-6.878	-1.194	-5.391	-2.041	7.044	2.126	-2.037	-8.178	-8.079	-4.227	-8.307	-5.318	0.000	-5.681	-9.716
		C4.728.asinh	7.281	0.885	0.914	-4.951	-12.396	-4.649	1.934	-3.170	0.996	8.556	7.669	2.634	-6.164	-5.933	-0.915	-6.669	-2.163	5.683	0.000	-5.377
		C4.728.hp	-4.219	2.288	4.347	-1.266	-8.360	-1.017	5.473	1.414	5.951	11.857	8.281	6.400	-2.445	-2.296	3.176	-1.020	2.687	8.716	5.377	

Figure 41: Diebold-Mariano Test for consumption forecasts (DK2)

Area	Dates	Model 1	C2 182	C2 364	C2 728	C3 182	C3 364	C3 728	C3 asinh	C3 hp	C3 364	C3 728	C3 asinh	C3 hp	C4 182	C4 364	C4 728	C4 asinh	C4 hp					
DK2	2019.05.13-2020.05.12	C2.182	0.000	2.117	2.086	5.109	-2.687	5.517	3.903	2.449	4.339	3.512	2.586	0.605	4.061	4.363	3.806	2.191	4.077	2.752	1.496	-0.024		
		C2.364	-2.117	0.000	4.047	2.430	-3.613	2.743	2.918	1.161	3.111	2.397	1.305	-0.937	1.688	1.919	2.789	0.852	2.995	1.501	0.046	-1.611		
		C2.728	-2.086	-0.407	0.000	2.124	-3.578	2.421	2.416	0.678	2.824	2.379	1.171	-1.176	1.425	1.652	2.318	0.601	2.558	1.402	-0.148	-1.883		
		C3.182	-5.109	-2.433	-2.124	0.000	-11.815	0.000	12.312	6.654	5.378	7.253	5.975	5.156	2.894	9.865	10.210	6.711	5.078	6.941	5.188	3.977	2.242	
		C3.182.asinh	2.687	3.613	3.578	11.815	0.000	12.312	6.654	5.378	7.253	5.975	5.156	2.894	9.865	10.210	6.711	5.078	6.941	5.188	3.977	2.242		
		C3.182.hp	-5.517	-2.743	-2.421	-3.063	0.000	0.570	-2.133	0.228	-0.828	-1.774	-3.885	-4.532	-3.824	-0.640	-2.427	-0.263	1.621	-2.949	-4.530			
		C3.364	-3.903	-2.918	-2.416	0.133	-6.854	0.570	0.000	-4.283	1.485	-0.586	-2.170	-4.426	-4.080	-0.456	-0.352	-4.554	0.657	1.932	-0.007	-5.236		
		C3.364.asinh	-2.449	-1.161	-0.878	1.750	-5.378	2.133	4.283	0.000	4.294	1.772	0.320	-2.502	0.841	1.136	3.547	-1.466	3.459	0.491	-1.765	-3.313		
		C3.364.hp	-4.339	-3.311	-2.824	-0.461	-7.253	-0.528	-0.485	-4.294	0.000	-1.313	-2.756	-6.611	-1.351	-1.039	-1.489	-4.615	-1.306	2.477	-4.431	-7.463		
		C3.728	-3.512	-2.397	-2.379	0.450	-5.979	0.828	0.588	-1.772	1.313	0.000	-2.899	-5.303	-0.372	-0.078	0.140	-2.156	0.886	3.490	5.334	-6.238		
		C3.728.asinh	2.586	-2.305	-1.771	-0.171	-3.487	0.828	0.588	-1.772	1.313	0.000	-2.899	-5.303	-0.372	-0.078	0.140	-2.156	0.886	3.490	5.334	-6.238		
		C3.728.hp	-0.605	0.937	1.176	3.428	-2.894	3.895	4.426	2.502	6.611	5.303	3.493	0.000	2.655	2.998	2.470	2.136	6.021	3.770	1.512	-3.320		
		C4.182	-4.061	-1.683	-1.425	3.436	9.865	4.532	0.800	-0.841	1.351	0.372	-0.592	-2.655	0.000	2.342	0.727	-1.163	1.073	0.441	-1.767	-3.302		
		C4.182.hp	-4.963	-1.919	-1.652	1.932	-10.262	3.824	4.586	-1.136	1.039	0.078	-0.869	-2.999	-2.342	0.000	0.382	-0.324	1.787	-0.923	2.073	0.000	-4.121	-5.262
		C4.364	-3.806	-2.898	-2.319	0.211	4.711	0.640	0.352	-3.547	1.489	-0.440	-1.967	-4.270	-0.727	-0.382	0.000	-4.867	0.949	1.786	3.825	-5.123		
		C4.364.hp	-4.077	-2.995	-2.553	-0.167	-6.941	0.263	-0.657	-3.459	1.306	-0.886	-2.292	-6.021	-1.073	-0.757	-0.949	-4.341	0.000	2.073	-4.008	-7.024		
		C4.728	-2.752	-1.751	-1.402	1.260	-5.188	1.621	1.932	-0.491	2.477	3.490	-0.389	-3.770	0.441	0.719	1.786	-0.923	2.073	0.000	-4.121	-5.262		
		C4.728.asinh	-1.948	-0.046	0.148	2.607	-3.977	2.949	4.007	1.785	4.431	5.334	4.968	-1.512	1.787	2.046	3.825	1.316	4.008	4.121	0.000	-2.749		
		C4.728.hp	0.024	1.611	1.883	4.066	-2.242	4.530	5.236	3.313	7.463	6.238	4.459	3.320	3.302	3.056	9.123	2.998	7.024	5.262	2.749			

Figure 42: Diebold-Mariano Test for consumption forecasts (DK2)

Area	Dates	Model 1	C2 182	C2 364	C2 728	C3 182	C3 364	C3 728	C3 asinh	C3 hp	C3 364	C3 728	C3 asinh	C3 hp	C4 182	C4 364	C4 728	C4 asinh	C4 hp			
DK2	2019.01.01-2020.05.12	C2.182	0.000	6.174	4.472	4.188	-5.821	4.689	6.054	2.757	6.139	5.954	4.302	1.988	2.766	3.179	4.671	1.204	4.548	4.474	2.526	7.2

Area	Dates	Model 1	C2_182	C2_364	C2_728	C3_182	C3_182	C3_182	C3_364	C3_364	C3_364	C3_728	C3_728	C3_728	C3_728	C4_182	C4_182	C4_364	C4_364	C4_364	C4_728	C4_728	C4_728
			182	364	728	182	182	hp	364	364	hp	728	728	728	hp	182	hp	364	364	hp	728	728	hp
DK2	2020.01.01-2020.05.12	C2.182	0.000	-3.683	-8.047	1.755	-3.697	2.299	-2.740	-3.795	-1.515	-6.175	-6.385	-5.377	1.574	2.052	-2.435	-3.637	-1.278	-6.187	-6.600	-5.576	
		C2.364	3.683	0.000	-10.983	3.988	-0.255	4.289	0.226	-1.300	1.752	-4.293	-4.663	-3.179	3.958	4.130	0.598	-1.101	1.996	-4.375	-4.974	-3.460	
		C2.728	8.047	10.983	0.000	7.515	3.126	7.717	4.981	3.316	6.090	0.252	-0.258	0.952	7.372	7.555	5.248	3.454	6.277	0.108	-0.660	0.633	
		C3.182	1.755	-3.988	7.515	0.000	-8.429	3.133	-4.389	-5.432	2.989	7.925	8.080	6.636	0.364	1.156	-4.027	5.254	2.712	7.919	9.260	7.020	
		C3.182.asinh	3.697	0.255	-3.126	8.479	0.000	-10.046	0.453	-0.724	1.639	-3.195	-3.543	-2.467	7.776	8.313	0.724	-0.583	1.845	-3.265	-3.813	-2.703	
		C3.182.hp	-2.299	-4.289	-7.717	-3.133	0.000	0.000	-4.696	-5.725	-3.421	-8.122	-8.281	-7.334	-1.936	-0.540	-4.345	-5.554	-3.144	-8.121	-8.479	-7.524	
		C3.364	2.740	-2.028	-4.981	4.389	-0.453	4.699	0.000	-4.310	4.261	-8.698	-8.766	-4.871	4.223	4.499	1.590	-3.315	4.323	-8.604	-9.005	-5.238	
		C3.364.asinh	3.795	1.300	-3.310	5.453	0.724	5.725	4.310	0.000	6.638	-5.130	-6.843	-7.976	5.260	5.523	4.480	0.869	6.556	-5.182	-7.132	-3.352	
		C3.364.hp	1.815	-1.752	-4.090	2.989	-1.639	3.421	-4.260	-6.638	0.000	9.342	-9.039	-8.681	2.856	3.245	-2.615	-5.749	1.282	-9.388	-10.111	-8.907	
		C3.728	6.175	4.293	-0.252	7.925	3.195	8.122	8.698	5.130	9.342	0.000	-1.573	1.300	7.757	7.935	8.801	5.233	9.426	-0.613	-2.324	0.712	
		C3.728.asinh	6.385	4.663	-0.258	8.066	3.543	8.261	8.769	6.841	9.839	1.573	0.000	2.032	7.883	8.083	8.838	6.795	9.866	0.960	-1.780	1.438	
		C3.728.hp	5.377	3.179	-0.955	6.832	2.467	7.334	4.871	2.971	8.861	-1.300	-2.022	0.000	6.715	7.172	5.190	3.139	8.789	-1.451	-2.543	-1.541	
		C4.182	-1.574	-3.858	-7.372	0.384	-7.776	1.939	-4.223	-5.260	-2.891	-7.757	-7.883	-6.715	0.000	2.854	-3.971	-5.196	-2.647	-7.845	-8.176	-6.966	
		C4.182.hp	-2.052	-4.130	-7.755	-1.156	-8.313	0.540	-4.499	5.523	-3.245	-7.935	-8.083	-7.172	-2.854	0.000	-4.256	-5.465	-3.043	-8.019	-8.388	-7.425	
		C4.364	2.435	-0.586	-5.248	4.027	-0.724	4.345	-1.590	-4.460	2.815	-8.801	-8.836	-5.190	3.971	4.256	0.000	-4.686	4.049	-8.992	-9.262	-5.591	
		C4.364.asinh	3.637	1.101	-3.454	5.254	0.583	5.554	3.315	-0.869	5.749	-5.233	-6.795	-3.139	5.198	5.465	4.688	0.000	6.784	5.447	-7.350	-3.562	
		C4.364.hp	2.617	1.996	-4.277	2.712	-1.845	3.144	-4.323	-4.556	-1.262	9.426	-9.866	-8.789	2.647	3.043	-4.049	-6.784	0.000	-8.617	-10.255	-9.970	
		C4.728	6.187	4.375	-0.108	7.919	3.205	8.121	8.604	5.182	9.368	0.613	-0.960	1.451	7.845	8.019	8.992	5.447	9.617	0.000	-2.419	0.976	
		C4.728.asinh	6.600	4.974	-0.660	8.260	3.813	8.479	9.025	7.132	10.111	2.324	1.780	2.543	8.176	8.368	9.262	7.350	10.255	2.419	0.000	2.152	
		C4.728.hp	5.576	3.460	-0.633	7.030	2.703	7.524	5.238	3.352	8.987	-0.712	-1.438	1.541	6.966	7.425	5.591	3.562	9.270	-0.976	-2.152	0.000	

Figure 44: Diebold-Mariano Test for consumption forecasts (DK2)

7.1.2 Wind power forecasts

Area	Dates	Model 1	W2_182	W2_182	W2_182	W2_364	W2_364	W2_364	W2_728	W2_728	W2_728	W3_182	W3_182	W3_182	W3_364	W3_364	W3_364	W3_728	W3_728	W3_728	W4_182	W4_182	W4_182	W4_364	W4_364	W4_364	W4_728	W4_728	W4_728	
			182	182	hp	182	182	hp	182	182	hp	182	182	hp	182	182	hp	182	182	hp	182	182	hp	182	182	hp	182	182	hp	
DK1	2019.01.01-2019.12.31	W2.182	0.000	-2.901	6.695	5.172	-10.45	-9.436	-6.888	-6.731	3.782	2.527	-11.197	-10.043	-6.051	-5.312	2.312	1.551	-12.439	-10.659										
		W2.182.hp	2.903	0.000	8.523	7.683	-9.902	-8.051	-3.904	-6.179	5.250	4.362	-10.208	-9.308	-8.797	-8.370	3.741	3.273	-11.376	-9.910										
		W2.364	-6.895	-8.523	0.000	-3.204	-18.413	-17.171	-9.724	-10.639	-4.643	-5.978	-18.895	-17.658	-8.890	-9.198	-6.791	-7.400	-20.128	-18.318										
		W2.364.hp	-5.172	-7.683	3.204	0.000	-18.492	-18.121	-8.269	-9.913	-1.737	-5.074	-17.944	-16.639	-7.666	-8.417	-3.803	-6.661	-18.172	-17.761										
		W2.728	10.545	9.502	18.413	16.492	0.000	5.493	6.969	6.601	15.624	14.129	-3.950	1.075	6.072	6.314	14.091	13.182	-5.282	0.261										
		W2.728.hp	9.436	8.651	17.171	16.121	-5.493	0.000	5.906	5.757	14.384	13.558	-6.613	-3.670	5.097	5.434	12.829	12.504	7.511	-3.500										
		W3.182	6.888	3.904	9.724	8.269	-6.969	-5.006	0.000	-1.028	6.892	6.774	-8.008	-8.657	-0.888	-0.245	7.023	5.871	-9.215	-7.341										
		W3.182.hp	6.731	6.179	10.639	9.913	-6.881	-5.157	1.026	0.000	9.182	8.453	-7.764	-6.749	0.107	0.757	7.988	7.394	-8.861	-7.205										
		W3.364	-3.766	-5.250	4.643	1.737	-15.621	-14.384	-8.392	-9.182	0.000	-2.917	-17.494	-15.980	-7.493	-8.754	-15.455	-15.101	-21.211	-18.708	-16.623									
		W3.364.hp	-3.257	-4.382	5.976	5.074	-14.129	-13.558	-6.774	-8.453	2.917	0.000	-15.652	0.000	5.652	7.010	7.254	15.801	14.630	-3.582	3.435									
		W3.728	11.167	10.208	18.865	17.044	3.950	6.013	8.083	7.764	17.462	15.652	0.000	5.652	7.010	7.254	15.801	14.630	-3.582	3.435										
		W3.728.hp	10.043	9.306	17.658	16.639	-1.075	3.670	6.857	6.749	15.980	15.101	-5.652	0.000	5.905	6.289	14.294	13.969	-6.388	-1.170										
		W4.182	6.051	3.797	8.890	7.668	-6.072	-5.097	0.888	-0.107	7.493	6.211	-7.010	-5.905	0.000	0.489	6.574	5.598	-8.004	-6.328										
		W4.182.hp	5.311	4.379	9.188	8.417	-6.314	5.434	0.245	-0.757	7.654	6.875	-7.254	-6.289	-0.481	0.000	6.541	6.171	-8.208	-6.725										
		W4.364	-2.311	-3.741	6.791	3.803	-14.09	-12.820	-7.028	-7.698	5.555	0.662	-15.884	-14.294	-6.574	-4.542	-15.624	-15.101	-21.211	-18.708	-15.340									
		W4.364.hp	-1.551	-3.273	7.400	6.661	-13.162	-12.504	-5.871	-7.394	4.955	4.612	-14.630	-13.969	-5.598	-4.171	1.824	0.000	-16.133	-14.933	-17.633									
		W4.728	10.659	9.910	18.318	17.281	-0.281	3.500	7.341	7.255	16.623	15.738	-3.435	1.170	6.328</															

Area	Dates	Model 1	W2_182_asinh-hp	W2_182_hp	W2_364_asinh-hp	W2_364_hp	W2_728_asinh-hp	W2_728_hp	W3_182_asinh-hp	W3_182_hp	W3_364_asinh-hp	W3_364_hp	W3_728_asinh-hp	W3_728_hp	W4_182_asinh-hp	W4_182_hp	W4_364_asinh-hp	W4_364_hp	W4_728_asinh-hp	W4_728_hp
DK1	2019.05.13-2020.05.12	W2.182.asinh-hp	0.000	-2.642	1.672	-0.401	-10.243	-9.508	-7.807	-7.311	-1.283	-2.626	-10.877	-9.961	-9.521	-7.833	-2.793	-3.401	-12.066	-10.490
		W2.182_hp	2.646	0.000	3.248	0.978	-9.717	-9.317	-5.049	-7.101	-0.095	-1.759	-10.596	-9.826	-7.366	-7.461	-1.700	-2.655	-11.657	-10.376
		W2.364.asinh-hp	-1.672	-3.242	0.000	-5.374	-17.774	-16.094	-5.924	-6.689	-5.686	-7.570	-17.494	-16.262	-7.747	-7.599	-7.719	-8.432	-18.539	-18.760
		W2.364_hp	0.401	-0.978	5.374	0.000	14.771	-14.922	-4.025	-4.885	-1.540	5.515	15.177	-15.189	-6.005	-6.035	-3.717	-6.542	-16.030	-18.811
		W2.728.asinh-hp	10.246	9.794	17.404	14.771	0.000	1.397	5.844	6.053	12.856	11.139	-3.255	-0.850	3.434	4.065	10.830	9.914	-4.506	-1.224
		W2.728_hp	9.508	9.317	16.094	14.927	-1.397	0.000	5.353	5.659	11.951	11.095	-3.481	-2.519	3.070	3.736	10.048	9.801	-4.561	-2.543
		W3.182.asinh-hp	7.807	5.040	5.924	4.025	-5.843	-5.353	0.000	-0.397	3.829	2.105	-6.96	-6.120	-5.071	-2.794	2.415	1.434	-7.993	-6.502
		W3.182_hp	7.311	7.101	6.689	4.885	-6.053	-5.658	0.397	0.000	4.410	2.823	-7.213	-6.523	-3.701	-3.257	2.654	1.944	-8.260	-6.955
		W3.364.asinh-hp	1.283	0.095	5.686	1.540	-12.856	-11.951	-3.829	-4.410	0.000	-3.987	15.432	-13.615	-5.917	-5.580	-5.648	-5.375	-16.034	-14.349
		W3.364_hp	2.626	1.759	7.570	5.515	-11.129	-11.095	-2.165	-2.823	3.987	0.000	-13.162	-12.991	-4.394	-4.268	0.052	-3.518	-14.130	-13.452
		W3.728.asinh-hp	10.877	10.508	17.460	15.177	3.255	3.488	6.964	7.213	15.432	13.195	0.000	2.483	4.317	4.982	13.067	11.798	-3.168	1.358
		W3.728_hp	9.961	9.826	16.262	15.189	0.850	2.519	6.126	6.523	13.815	12.991	-2.483	0.000	3.668	4.396	11.647	11.495	-3.877	-0.958
		W4.182.asinh-hp	9.521	7.366	7.747	6.005	-3.434	-3.070	5.077	5.370	5.917	4.394	-4.317	-3.668	0.000	1.404	4.897	3.900	-5.128	-3.946
		W4.182_hp	7.833	7.461	7.599	6.035	-4.065	-3.736	2.794	3.257	5.580	4.268	-4.982	-4.396	-1.404	0.000	4.419	3.715	-5.775	-4.691
		W4.364.asinh-hp	2.798	1.700	7.719	3.717	-10.048	-2.415	-2.854	5.848	-0.052	-13.067	-11.647	-4.897	-4.419	0.000	-2.105	-14.956	-12.620	
		W4.364_hp	3.401	2.655	8.432	6.542	-9.914	-9.801	-1.434	1.944	5.375	3.518	-11.786	-11.405	-3.900	-3.715	2.105	0.000	-13.001	12.295
		W4.728.asinh-hp	12.066	11.657	16.559	16.050	4.506	4.561	7.994	8.260	16.634	14.130	3.168	3.877	5.128	5.775	14.956	13.081	0.000	4.443
		W4.728_hp	10.480	10.376	16.780	15.617	1.224	2.543	6.502	6.955	14.349	13.452	-1.358	0.958	3.948	4.691	12.620	12.295	-4.343	0.000

Figure 46: Diebold-Mariano Test for wind power forecasts (DK1)

Area	Dates	Model 1	W2_182_asinh-hp	W2_182_hp	W2_364_asinh-hp	W2_364_hp	W2_728_asinh-hp	W2_728_hp	W3_182_asinh-hp	W3_182_hp	W3_364_asinh-hp	W3_364_hp	W3_728_asinh-hp	W3_728_hp	W4_182_asinh-hp	W4_182_hp	W4_364_asinh-hp	W4_364_hp	W4_728_asinh-hp	W4_728_hp
DK1	2018.01.01-2020.05.12	W2.182.asinh-hp	0.000	-3.402	1.196	-0.822	-15.854	-15.171	-8.616	-8.346	-2.025	-3.595	-16.664	-15.912	-8.954	-7.787	-3.447	-4.272	-17.747	-16.463
		W2.182_hp	3.402	0.000	3.032	0.897	-15.071	-14.943	-5.251	-7.766	-0.517	-2.452	-15.973	-15.643	-6.469	-6.956	-1.969	-3.220	-16.979	-16.232
		W2.364.asinh-hp	-1.198	-3.032	0.000	-5.042	-23.129	-22.261	-6.032	-6.900	-6.498	-8.542	-23.149	-22.741	-7.017	-7.017	-8.382	-9.262	-24.396	-23.222
		W2.364_hp	0.822	-0.897	5.042	0.000	20.427	-21.161	-4.163	5.248	-2.119	-7.002	21.068	-21.715	-5.905	-5.567	-4.129	-7.753	-21.810	-22.234
		W2.728.asinh-hp	15.854	15.071	23.124	20.427	0.000	11.034	11.110	18.829	16.760	-5.019	-2.172	8.770	8.231	17.075	15.759	-5.741	-2.288	
		W2.728_hp	15.171	14.843	22.261	21.161	-1.625	0.000	10.903	10.827	18.116	17.105	-4.906	-4.705	8.341	8.949	16.396	16.055	-5.664	-4.181
		W3.182.asinh-hp	8.616	5.251	6.032	4.163	-11.034	-10.503	0.000	-0.944	3.565	1.719	-12.571	-11.783	-3.535	-2.117	2.168	1.044	-13.551	-12.224
		W3.182_hp	8.348	7.766	6.900	5.248	-11.146	-10.827	0.944	0.000	4.278	2.545	-12.645	-12.213	-3.142	-1.958	2.783	1.742	-13.594	-12.696
		W3.364.asinh-hp	2.028	0.517	6.498	2.118	18.829	-18.116	-3.565	-4.278	0.000	-4.419	21.537	-20.383	-4.832	-4.665	-5.682	-5.596	-22.541	-20.893
		W3.364_hp	3.955	2.482	8.542	7.002	-18.104	-17.095	-1.719	2.545	4.419	0.000	-18.964	-19.438	-3.220	-3.214	0.672	-3.261	-18.783	-19.897
		W3.728.asinh-hp	16.664	15.973	23.496	21.082	5.019	4.906	12.576	12.644	21.537	18.996	0.000	2.375	16.022	16.490	19.599	17.904	-3.030	1.456
		W3.728_hp	15.912	15.643	22.741	21.715	2.172	4.705	11.783	12.218	20.383	19.438	-2.375	0.000	9.392	10.069	18.491	18.205	-3.707	0.818
		W4.182.asinh-hp	8.954	6.490	7.017	5.365	-9.770	-9.341	3.538	2.142	4.832	3.220	-10.069	-9.992	0.000	0.800	3.781	2.724	-10.779	-9.720
		W4.182_hp	7.787	6.956	7.017	5.567	-9.231	-8.949	2.117	1.958	4.665	3.214	-10.490	-10.069	-0.800	0.000	3.509	2.659	-11.189	-10.395
		W4.364.asinh-hp	3.447	1.869	8.382	4.139	-17.004	-16.396	-2.168	-2.783	5.682	-0.672	-19.599	-18.401	-3.781	-3.500	0.000	-2.521	-21.205	-19.405
		W4.364_hp	4.272	3.220	9.262	7.753	-15.759	-16.065	-1.044	-1.742	5.598	3.261	-17.904	-18.205	-2.724	-2.659	2.521	0.000	-19.011	-19.015
		W4.728.asinh-hp	17.747	16.979	24.396	21.810	5.741	5.664	13.551	13.594	22.541	19.793	3.030	3.707	10.779	11.189	21.205	19.011	0.000	4.066
		W4.728_hp	16.463	16.312	23.222	22.134	2.288	4.181	12.224	12.698	20.893	19.897	-1.456	0.818	9.720	10.395	19.435	19.015	-4.066	0.000

Figure 47: Diebold-Mariano Test for wind power forecasts (DK1)

Area	Dates	Model 1	W2_182_asinh-hp	W2_182_hp	W2_364_asinh-hp	W2_364_hp	W2_728_asinh-hp	W2_728_hp	W3_182_asinh-hp	W3_182_hp	W3_364_asinh-hp	W3_364_hp	W3_728_asinh-hp	W3_728_hp	W4_182_asinh-hp	W4_182_hp	W4_364_asinh-hp	W4_364_hp	W4_728_asinh-hp	W4_728_hp
DK1	2020.01.01-2020.05.12	W2.182.asinh-hp	0.000	-1.777	-6.592	-7.508	-12.741	-12.843	-5.179	-4.943	-8.337	-9.003	-13.256	-13.319	-6.714	-5.762	-8.862	-8.626	-13.248	-13.300
		W2.182_hp	1.777	0.000	-6.542	-8.344	-13.390	-13.341	-3.591	-4.712	-8.493	-9.093	-13.099	-14.346	-6.696	-5.501	-8.632	-9.440	-13.820	-14.368
		W2.364.asinh-hp	6.592	6.542	0.000	-4.130	-15.259	-15.957	2.416	2.640	-6.460	-6.257	-14.261	-15.002	-0.138	-1.146	-4.914	-5.576	-14.101	-14.711
		W2.364_hp	7.500	8.344	4.130	0.000	-13.256	-15.540	3.541	4.105	-1.212	-4.932	-13.261	-15.476	0.993	1.353	-1.775	-4.034	-12.409	-14.913
		W2.728.asinh-hp	12.741	13.390	15.229	13.256	0.000	-4.121												

			W1 728	W2 182	W2 364	W2 728	W2 asinh	W3 182	W3 182 asinh	W3 364	W3 364 asinh	W3 728	W3 728 asinh
Area	Dates	Model 1											
DK2 2019.01.01-2019.12.31	W1.728	0.000	-7.716	-2.480	-3.385	-5.141	-8.930	-10.782	-3.392	-5.060	-3.753	-5.831	
	W2.182	7.716	0.000	8.550	4.042	1.136	-4.090	-7.964	5.917	2.454	3.322	0.154	
	W2.364	2.480	-8.550	0.000	-2.602	-5.589	-9.348	-12.243	-2.600	-6.103	-3.095	-6.340	
	W2.728	3.385	-4.042	2.602	0.000	-9.647	-5.758	-8.914	0.807	-2.345	-1.631	-7.931	
	W2.728.asinh	5.141	-1.136	5.589	9.647	0.000	-3.024	-6.253	3.817	1.171	4.921	-2.741	
	W3.182	8.930	4.090	9.348	5.758	3.024	0.000	-7.383	9.189	5.220	5.468	2.192	
	W3.182.asinh	10.782	7.964	12.243	8.914	6.253	7.383	0.000	12.265	9.655	8.752	5.518	
	W3.364	3.392	-5.917	2.600	-0.807	-3.817	-9.189	-12.265	0.000	-6.107	-1.684	-5.239	
	W3.364.asinh	5.060	-2.454	6.103	2.345	-1.171	-5.220	-9.655	6.107	0.000	1.732	-2.681	
	W3.728	3.753	-3.322	3.095	1.631	-4.921	-5.468	-8.752	1.684	-1.732	0.000	-10.515	
	W3.728.asinh	5.831	-0.154	6.340	7.931	2.741	-2.192	-5.518	5.239	2.681	10.515	0.000	

Figure 49: Diebold-Mariano Test for wind power forecasts (DK2)

			W1 728	W2 182	W2 364	W2 728	W2 asinh	W3 182	W3 182 asinh	W3 364	W3 364 asinh	W3 728	W3 728 asinh
Area	Dates	Model 1											
DK2 2019.05.13-2020.05.12	W1.728	0.000	-12.972	-6.299	-4.783	-4.606	-14.333	-14.697	-7.340	-7.594	-5.149	-5.166	
	W2.182	12.972	0.000	11.993	9.789	8.322	-5.382	-7.924	8.037	5.548	8.696	7.192	
	W2.364	6.299	-11.993	0.000	2.167	0.937	-12.614	-14.270	-3.546	-5.445	0.882	-0.327	
	W2.728	4.783	-9.789	-2.167	0.000	-1.961	-11.427	-13.386	-4.016	-5.654	-1.885	-3.162	
	W2.728.asinh	4.606	-8.322	-0.937	1.961	0.000	-10.165	-12.629	-2.835	-4.874	-0.123	-2.331	
	W3.182	14.333	5.382	12.614	11.427	10.165	0.000	-5.698	12.651	9.496	11.556	9.906	
	W3.182.asinh	14.697	7.924	14.270	13.386	12.629	5.698	0.000	14.194	12.762	13.544	12.520	
	W3.364	7.340	-8.037	3.546	4.016	2.835	-12.651	-14.194	0.000	-4.192	3.491	1.846	
	W3.728	5.149	-8.696	-0.882	1.885	0.123	-11.556	-13.544	-3.491	-5.262	0.000	-2.687	
	W3.728.asinh	5.166	-7.192	0.327	3.162	2.331	-9.906	-12.520	-1.846	-4.032	2.687	0.000	

Figure 50: Diebold-Mariano Test for wind power forecasts (DK2)

			W1 728	W2 182	W2 364	W2 728	W2 asinh	W3 182	W3 182 asinh	W3 364	W3 364 asinh	W3 728	W3 728 asinh
Area	Dates	Model 1											
DK2 2019.01.01-2020.05.12	W1.728	0.000	-8.590	-1.737	-1.066	-2.570	-11.161	-12.368	-3.806	-5.255	-2.003	-3.890	
	W2.182	8.590	0.000	11.770	8.556	5.664	-6.954	-9.764	6.914	3.314	7.056	3.824	
	W2.364	1.737	-11.770	0.000	0.819	-2.147	-13.616	-15.569	-5.308	-8.027	-0.915	-4.131	
	W2.728	1.066	-8.556	-0.819	0.000	-6.873	-11.232	-13.644	-3.817	-6.631	-3.302	-8.065	
	W2.728.asinh	2.570	-5.664	2.147	6.873	0.000	-8.550	-11.396	-0.830	-3.849	2.127	-4.593	
	W3.182	11.161	6.954	13.616	11.232	8.550	0.000	-6.751	12.616	8.101	10.753	7.298	
	W3.182.asinh	12.368	9.764	15.569	13.644	11.396	6.751	0.000	14.668	11.968	13.262	10.273	
	W3.364	3.806	-6.914	5.308	3.817	0.830	-12.616	-14.668	0.000	-6.076	2.520	-1.369	
	W3.728	5.255	-3.314	8.027	6.631	3.849	-8.101	-11.968	6.076	0.000	5.642	1.724	
	W3.728.asinh	3.890	-3.824	4.131	8.065	4.593	-7.298	-10.273	1.369	-1.724	8.596	0.000	

Figure 51: Diebold-Mariano Test for wind power forecasts (DK2)

			W1 728	W2 182	W2 364	W2 728	W2 asinh	W3 182	W3 182 asinh	W3 364	W3 364 asinh	W3 728	W3 728 asinh
Area	Dates	Model 1											
		W1.728	0.000	-3.986	0.454	4.221	3.843	-6.710	-6.137	-1.813	-2.013	2.857	2.426
		W2.182	3.986	0.000	8.836	10.982	10.507	-6.584	-5.765	3.577	2.369	9.092	8.309
		W2.364	-0.454	-8.836	0.000	7.381	6.971	-10.846	-9.853	-5.435	-5.311	4.140	3.637
		W2.728	-4.221	-10.982	-7.381	0.000	1.353	-12.832	-11.778	-9.232	-8.577	-3.759	-2.483
		W2.728.asinh	-3.843	-10.507	-6.971	-1.353	0.000	-12.505	-12.161	-9.069	-9.660	-3.552	-4.447
DK2	2020.01.01-2020.05.12	W3.182	6.710	6.584	10.846	12.832	12.505	0.000	-0.339	9.344	7.136	12.777	11.820
		W3.182.asinh	6.137	5.765	9.853	11.778	12.161	0.339	0.000	8.085	7.170	11.443	11.392
		W3.364	1.813	-3.577	5.435	9.232	9.069	-9.344	-8.085	0.000	-1.652	8.924	7.778
		W3.364.asinh	2.013	-2.369	5.311	8.577	9.660	-7.136	-7.170	1.652	0.000	7.867	8.442
		W3.728	-2.857	-9.092	-4.140	3.759	3.552	-12.777	-11.443	-8.924	-7.867	0.000	0.124
		W3.728.asinh	-2.426	-8.309	-3.637	2.483	4.447	-11.820	-11.392	-7.778	-8.442	-0.124	0.000

Figure 52: Diebold-Mariano Test for wind power forecasts (DK2)

7.1.3 Price forecasts

			P4 182	P4 182 asinh	P4 hp	P4 364	P4 364 asinh	P4 728	P4 728 asinh	P5 182	P5 182 asinh	P5 hp	P5 728	P5 728 asinh	P5 728 hp							
Area	Dates	Model 1																				
		P4.182	0.000	20.777	22.059	6.486	13.093	13.678	2.594	11.473	16.592	11.859	6.578	-4.806	18.971	20.010	-0.064	11.149	16.425	13.152	8.062	
		P4.182.asinh	20.277	0.000	6.591	-18.746	0.063	0.978	-10.004	-1.059	4.243	0.071	-5.096	-21.158	-7.439	-1.211	-20.983	-2.009	4.022	1.328	-3.887	
		P4.182.asinh	-21.059	-8.591	0.000	-20.008	-0.623	0.424	-10.478	-2.134	3.729	-0.405	-5.571	-21.854	-8.599	-6.071	-21.195	-2.484	3.496	0.856	-4.353	
		P4.182.hp	-6.486	19.140	20.609	0.000	12.963	13.590	2.260	11.207	15.349	11.672	6.349	-6.618	11.011	18.511	-3.249	10.856	16.149	12.965	7.805	
		P4.182.hp	13.093	0.063	0.623	-12.763	0.000	5.001	-13.443	-2.459	6.782	0.160	-6.578	-13.505	-8.800	-0.077	-15.022	-3.168	6.739	1.845	-5.220	
		P4.364.asinh	13.093	0.063	0.623	-12.763	0.000	5.001	-13.443	-2.459	6.782	0.160	-6.578	-13.505	-8.800	-0.077	-15.022	-3.168	6.739	1.845	-5.220	
		P4.364.asinh	-13.078	-0.978	-0.424	-13.596	5.000	0.000	-19.101	-3.957	5.387	-1.079	-1.079	-8.323	-14.180	-1.803	-1.079	-13.733	-4.612	5.049	0.708	-6.872
		P4.364.asinh	10.004	10.478	-2.260	17.443	19.101	0.000	17.476	19.338	11.838	6.473	-3.053	0.153	9.765	-2.551	18.011	19.514	13.678	9.183		
		P4.364.hp	-13.078	-0.978	-0.424	-13.596	5.000	0.000	-19.101	-3.957	5.387	-1.079	-1.079	-8.323	-14.180	-1.803	-1.079	-13.733	-4.612	5.049	0.708	-6.872
		P4.728	11.473	1.659	2.134	11.207	2.459	3.907	17.476	0.000	13.267	2.907	10.471	-11.735	0.921	1.529	11.328	-2.163	10.499	5.171	-8.138	
		P4.728.asinh	10.692	-4.243	-3.729	16.346	-6.782	-5.307	18.336	-11.267	0.000	-9.148	14.864	-16.961	-0.024	-4.366	16.973	-11.970	-1.784	-7.124	-13.795	
		P4.728.hp	-11.059	-0.071	0.405	-11.676	-0.168	1.079	-11.838	-2.907	9.148	0.000	-11.408	-12.115	-0.794	-0.186	-11.806	-3.123	7.053	13.053	-8.981	
		P4.728.hp	-6.578	5.096	5.571	-6.346	6.571	8.323	-6.473	10.471	14.964	11.498	0.000	-6.853	4.359	4.952	-6.492	7.323	13.431	13.494	11.888	
		P5.182	4.806	21.158	21.854	6.616	13.950	14.188	3.053	11.735	16.961	12.115	6.853	0.000	20.296	21.179	9.073	11.504	16.877	13.430	8.339	
		P5.182.asinh	18.971	7.439	9.598	18.411	1.800	1.801	-9.153	-0.921	5.024	0.794	-4.359	-20.206	0.000	10.562	19.388	-1.265	4.834	2.051	-3.167	
		P5.182.asinh	-20.010	1.211	6.071	-19.533	0.077	1.097	-9.765	4.366	0.189	-4.952	-21.179	-10.562	0.000	-20.465	-1.880	4.156	1.448	-3.756		
		P5.182.hp	0.064	20.933	21.195	3.249	13.022	13.733	2.551	11.328	16.577	11.806	6.492	-9.073	19.381	-0.405	0.000	11.061	16.451	13.121	7.981	
		P5.728	-11.149	2.009	2.494	-10.856	3.196	4.612	18.001	2.163	11.979	3.123	-7.323	-11.504	1.265	1.880	-11.098	0.000	11.908	5.296	-5.373	
		P5.728.asinh	16.426	-4.022	-2.496	16.148	6.739	5.049	-19.514	-10.499	1.784	-7.053	13.431	16.872	-4.834	-4.156	16.403	-11.908	0.000	-5.294	-12.479	
		P5.728.asinh	13.152	-1.328	-0.856	-12.965	-1.845	-0.708	-13.678	-5.171	7.124	-13.053	-13.494	-13.430	-0.051	-1.448	-13.121	-5.286	5.294	0.000	-11.134	
		P5.728.hp	-8.062	3.887	4.353	-7.835	5.220	6.872	-9.183	8.138	13.799	8.581	-11.888	-8.339	3.167	3.756	-7.981	5.373	12.473	11.134	0.000	

Figure 53: Diebold-Mariano Test for price forecasts (DK1)

Area	Dates	Model 1	P4_182	P4_182_asinh	P4_182_asinh_hp	P4_182_hp	P4_364	P4_364_asinh	P4_364_asinh_hp	P4_728	P4_728_asinh	P4_728_asinh_hp	P4_728_hp	P5_182	P5_182_asinh	P5_182_asinh_hp	P5_182_hp	P5_728	P5_728_asinh	P5_728_asinh_hp	P5_728_hp
DK1	2019.05.13-2020.05.12	P4.182	0.000	5.229	5.553	3.964	-6.999	-5.366	-7.622	5.019	1.171	1.321	7.629	-9.062	3.944	4.592	-5.949	2.060	-0.118	1.864	7.891
		P4.182_asinh	-5.229	0.000	3.858	4.910	13.393	-11.569	-10.279	0.94	-2.597	-2.197	3.424	-6.972	-7.180	-4.089	-6.259	-1.758	-4.215	-1.676	3.613
		P4.182_asinh_hp	-5.553	-3.658	0.000	5.250	13.443	-11.707	-10.413	0.73	-2.767	-2.421	3.224	-7.274	-7.369	-5.734	-6.589	-1.955	-4.401	-1.908	3.402
		P4.182_hp	-3.964	4.910	5.250	0.000	-7.126	-5.525	-7.756	4.762	0.963	1.145	7.427	-9.196	3.624	4.281	-7.475	1.821	-0.301	1.862	7.675
		P4.364	6.999	13.354	13.413	7.126	0.000	14.128	0.804	13.340	11.957	9.797	14.208	5.906	12.460	12.773	6.38	11.108	11.364	11.385	15.057
		P4.364_asinh	5.369	11.569	11.707	5.525	14.128	0.000	-1.695	11.446	9.704	8.227	12.800	4.202	10.527	10.942	4.641	8.798	8.510	9.712	13.510
		P4.364_hp	7.622	10.279	10.413	7.756	-0.804	1.695	0.000	14.173	8.027	7.216	14.171	6.326	9.565	9.809	6.779	14.374	7.065	8.101	17.436
		P4.728	5.019	-0.948	-0.733	-4.762	-13.440	-11.468	-18.869	0.000	-4.956	-5.578	7.317	-6.826	-1.866	-1.417	-5.754	-10.365	-3.397	-3.030	7.680
		P4.728_asinh	-1.171	2.557	2.707	-1.961	11.957	-0.702	-8.027	4.956	0.000	0.579	7.150	-2.273	1.563	2.014	-1.827	0.764	-1.617	2.242	7.401
		P4.728_asinh_hp	-1.921	2.197	2.421	-1.146	-9.767	-8.227	-7.216	3.578	-0.579	0.000	7.181	-2.354	1.238	1.680	-1.943	0.402	-3.087	2.899	7.076
		P4.728_hp	-7.629	-3.424	3.224	7.477	14.208	-12.800	-16.671	7.817	-7.150	-7.161	0.000	8.730	-4.281	-3.871	-8.265	-9.805	-8.614	-6.548	4.036
		P5.182	9.062	6.972	7.274	9.156	5.906	-4.202	-6.326	6.326	2.273	2.354	8.738	0.000	5.629	6.467	8.103	3.452	1.007	2.941	9.181
		P5.182_asinh	-3.944	7.180	7.369	5.624	-12.460	-10.527	-9.565	1.860	-1.593	-1.238	4.281	-5.829	0.000	7.067	-5.000	-0.871	-1.353	-0.695	4.550
		P5.182_asinh_hp	-4.592	4.089	5.734	-4.281	12.777	-10.942	-9.899	1.417	-2.014	-1.680	3.871	-6.467	-7.067	0.000	5.743	-1.300	-3.690	-1.159	4.115
		P5.182_hp	5.949	0.259	6.589	7.475	-6.304	-6.464	6.779	5.754	1.827	1.943	8.265	-8.103	5.080	5.743	0.000	2.879	0.556	2.513	8.673
		P5.728	-2.000	1.758	1.955	-1.821	-11.108	-14.394	-10.365	-0.764	-9.805	-3.452	0.871	1.300	-2.879	0.000	-2.880	0.230	12.886		
		P5.728_asinh	0.118	4.215	4.091	0.301	-11.364	-8.510	-7.095	6.397	6.197	3.087	6.014	-1.007	3.253	3.690	-0.556	2.880	0.000	5.119	9.311
		P5.728_asinh_hp	-1.864	1.676	1.906	-1.682	-11.385	-9.712	-8.101	3.030	-2.242	-2.899	6.548	-2.941	0.695	1.159	-2.513	-0.230	-5.139	0.000	6.798
		P5.728_hp	-7.891	-2.613	-3.402	-7.875	-23.057	-15.510	-17.420	7.880	-7.401	-7.076	-4.036	-9.181	-4.550	-4.115	-8.673	-12.586	-9.311	-6.788	0.000

Figure 54: Diebold-Mariano Test for price forecasts (DK1)

Area	Dates	Model 1	P4_182	P4_182_asinh	P4_182_asinh_hp	P4_182_hp	P4_364	P4_364_asinh	P4_364_asinh_hp	P4_728	P4_728_asinh	P4_728_asinh_hp	P4_728_hp	P5_182	P5_182_asinh	P5_182_asinh_hp	P5_182_hp	P5_728	P5_728_asinh	P5_728_asinh_hp	P5_728_hp	
DK1	2019.01.01-2020.05.12	P4.182	0.000	11.711	15.000	10.001	4.935	5.918	0.823	10.800	8.902	5.541	7.463	-3.370	13.884	-14.065	1.620	9.596	8.360	6.292	7.952	
		P4.182_asinh	-14.744	0.000	10.616	-13.983	-5.634	-4.386	-0.860	0.772	-0.389	-3.239	-1.639	-15.615	-4.707	1.544	-14.979	-0.487	-0.807	-2.564	-1.397	
		P4.182_asinh_hp	-15.660	-10.616	0.000	14.022	-6.291	-5.066	-0.956	0.210	-0.995	-3.824	-2.169	-16.447	-7.804	-2.805	-15.285	-1.057	-1.422	-3.156	-1.870	
		P4.182_hp	-10.061	13.983	14.012	0.000	4.443	5.438	0.860	10.440	8.141	5.145	7.056	-4.743	12.887	14.242	-1.856	9.096	7.902	5.891	7.443	
		P4.364	-9.493	5.634	6.291	-4.443	-6.410	-6.410	-6.102	-6.729	7.001	6.675	1.094	3.044	-5.488	4.822	5.903	-4.095	5.684	6.718	2.771	3.527
		P4.364_asinh	-5.918	4.380	5.06	-5.438	-6.410	0.000	-8.334	5.853	5.200	0.465	2.079	-6.431	3.554	4.555	-5.665	4.311	4.938	1.547	2.548	
		P4.364_hp	-0.623	9.080	9.652	-0.080	-6.729	8.331	0.000	17.899	10.222	6.011	9.839	-1.233	8.364	9.198	-0.358	16.525	10.317	7.029	10.673	
		P4.728	-10.888	-0.772	-0.210	-10.410	-7.001	-1.788	-0.789	17.994	-1.788	-5.722	-7.269	-1.206	-1.373	-0.565	-10.461	-4.717	-2.404	-4.813	-6.105	
		P4.728_asinh	-8.562	0.389	0.965	-8.141	-6.675	-5.201	-10.222	1.798	0.000	-7.818	-1.943	-9.028	-0.276	0.597	-8.328	-0.185	-1.862	-5.767	-1.482	
		P4.728_asinh_hp	-10.888	-0.772	-0.210	-10.410	-7.001	-1.788	-0.789	17.994	-1.788	-5.722	-7.269	-1.206	-1.373	-0.565	-10.461	-4.717	-2.404	-4.813	-6.105	
		P4.728_hp	-7.463	1.639	2.146	-7.056	-3.044	-2.078	-1.789	7.269	1.943	-2.253	0.000	-7.768	1.050	1.805	-7.123	2.677	1.385	-1.133	1.929	
		P5.182	3.976	19.617	16.417	6.743	5.488	4.633	1.235	11.206	9.028	5.938	7.768	0.000	14.979	16.749	13.379	10.126	8.900	6.731	8.245	
		P5.182_asinh	-13.684	4.707	7.804	-12.887	-4.822	-3.554	-8.364	1.373	0.276	-2.554	-1.050	-14.978	0.000	13.347	13.347	-1.042	-0.122	-1.902	-0.754	
		P5.182_asinh_hp	-14.985	-15.444	2.86	-14.242	-5.803	-4.555	-9.198	0.566	-0.957	-3.389	-1.805	-16.249	-13.347	0.000	-15.035	-0.691	-1.025	-2.756	-1.521	
		P5.182_hp	-1.628	14.379	15.205	1.856	4.695	5.665	0.256	10.401	8.226	5.303	7.123	-13.378	13.673	-15.039	0.000	9.329	8.163	6.087	7.592	
		P5.728	-0.596	0.407	1.057	-0.096	-5.684	-4.313	-11.623	5.717	0.185	-3.006	-2.677	-10.126	-0.142	0.691	-9.329	0.000	-0.423	-2.841	-2.279	
		P5.728_asinh	-0.360	0.807	1.422	-7.902	-6.718	-9.438	-10.317	2.404	1.962	-5.175	-1.385	-9.900	0.121	1.025	-8.163	0.423	0.000	-4.219	-0.977	
		P5.728_asinh_hp	-6.292	2.564	3.156	-5.891	-2.771	-1.547	-7.029	4.813	5.767	-4.213	1.133	-6.731	1.902	2.756	-6.087	2.841	4.219	0.000	1.725	
		P5.728_hp	-7.852	1.337	1.870	-7.443	-3.527	-2.548	-10.673	6.105	1.462	-2.721	-1.929	-8.245	0.754	1.521	-7.592	2.279	0.977	-1.725	0.000	

Figure 55: Diebold-Mariano Test for price forecasts (DK1)

Area	Dates	Model 1	P4_182	P4_182_asinh	P4_182_asinh_hp	P4_182_hp	P4_364	P4_364_asinh	P4_364_asinh_hp	P4_728	P4_728_asinh	P4_728_asinh_hp	P4_728_hp	P5_182	P5_182_asinh	P5_182_asinh_hp	P5_182_hp	P5_728	P5_728_asinh	P5_728_asinh_hp	P5_728_hp	
DK1	2020.01.01-2020.05.12	P4.182	0.000	-5.871	-5.401	10.142	-12.859	-12.506	-5.698	1.953	-4.902	-8.576	3.635	-12.900	-8.840	-8.099	-10.096	-4.812	-12.438	-10.936	-0.717	
		P4.182_asinh	5.871	0.000	6.768	6.461	-12.737	-12.288	0.466	5.140	-7.737	-8.700	0.974	-9.060	-6.924	1.883	0.000	-11.677	-9.721	3.712		
		P4.182_asinh_hp	5.401	-6.768	0.000	6.031	-13.001	-12.597	0.076	4.778	-7.999	-6.977	7.006	0.052	-9.980	-8.220	1.447	-0.285	-11.888	-9.961	3.348	
		P4.182_hp	-10.142	-6.481	-6.031	0.000	-13.169	-12.831	-6.298	-0.511	-9.711	-8.800	3.113	-14.021	-9.421	-9.714	-12.146					

Area	Dates	Model 1	P4_182	P4_182_asinh	P4_182_hp	P4_364	P4_364_asinh	P4_364_hp	P4_728	P4_728_asinh	P4_728_hp	P5_182	P5_182_asinh	P5_182_hp	P5_364	P5_364_asinh	P5_364_hp	P5_728	P5_728_asinh	P5_728_hp	
DK2	2019.01.01-2019.12.31	P4.182	0.000	0.867	18.818	3.585	-3.200	11.068	11.853	7.604	10.012	12.609	5.639	-2.373	18.512	18.771	-0.798	11.917	7.656	15.641	
		P4.182_asinh	-0.567	0.000	4.818	18.441	-13.891	-1.174	-0.330	-3.488	4.481	1.688	-4.713	18.867	-0.417	2.537	-18.550	-0.261	-3.427	4.523	4.274
		P4.182_hp	19.626	4.818	0.000	18.719	-14.028	-1.341	-0.498	-3.624	4.232	1.551	-4.853	18.807	-3.179	-0.467	-18.928	-0.429	-3.565	4.274	1.627
		P4.182_zcp	-3.585	0.841	18.719	0.000	-3.344	11.007	11.802	7.553	15.571	12.580	5.581	-3.511	18.392	18.656	-2.427	11.866	7.606	15.601	
		P4.364	3.200	13.868	14.000	3.344	0.000	21.778	22.057	18.388	23.787	17.326	11.875	3.124	13.839	13.976	3.207	22.730	18.464	23.803	
		P4.364_asinh	-11.069	1.17	1.341	11.007	-21.778	0.000	5.987	-3.938	9.137	3.599	5.227	11.139	1.149	1.314	-11.081	6.372	-3.847	9.189	3.699
		P4.364_hp	11.053	0.330	0.498	11.802	-22.657	-5.987	0.000	-5.115	8.24	2.832	-6.432	11.924	0.310	0.475	-11.976	1.096	-5.019	8.171	2.941
		P4.728	-7.604	3.464	3.624	-7.553	18.388	3.936	5.115	0.000	18.841	8.602	-5.143	-7.705	3.468	3.604	-7.658	5.203	2.376	13.865	8.724
		P4.728_asinh	-15.613	4.481	4.481	-15.576	23.787	-9.137	-8.124	-14.843	0.000	-6.617	15.513	10.701	-4.491	-4.435	-15.667	-8.021	-14.729	1.077	-4.416
		P4.728_hp	-12.609	1.686	1.551	-12.580	17.328	-3.399	-8.835	-8.602	6.117	0.000	-12.763	12.717	-1.704	-1.569	-12.690	-2.747	-8.492	6.691	3.206
		P5.182	-6.359	4.713	4.853	-5.591	11.875	5.221	6.433	5.146	10.140	12.763	0.000	-5.745	4.699	4.837	-5.699	6.502	5.303	15.161	12.887
		P5.182_asinh	2.377	0.667	1.967	3.511	-1.312	11.139	11.924	7.705	15.701	12.717	5.745	0.000	18.674	18.933	3.479	11.997	7.763	15.731	12.788
		P5.182_hp	16.853	0.417	3.179	18.382	13.839	-1.149	-0.310	-4.468	4.491	4.699	18.674	0.000	4.747	18.552	-0.241	-3.416	4.535	1.780	-4.665
		P5.364	0.777	2.537	0.467	18.659	-13.976	-1.314	-0.475	-3.604	4.345	1.598	-4.837	18.933	-4.747	0.000	-18.829	-0.406	-3.546	4.388	1.645
		P5.364_asinh	0.798	1.550	1.843	2.427	-3.207	11.081	11.876	7.658	15.661	12.699	5.689	-3.479	15.861	15.850	0.000	18.949	7.715	15.761	
		P5.364_hp	-11.917	0.260	0.429	11.896	-22.730	-6.372	-1.696	-5.203	8.021	2.747	6.502	-11.997	0.241	0.406	-11.949	0.000	-5.119	0.084	2.857
		P5.728	7.658	3.427	3.565	-7.608	18.464	3.847	5.019	-2.379	14.791	8.482	5.303	-7.763	3.410	3.546	-7.715	5.113	0.000	14.793	8.627
		P5.728_asinh	15.642	4.523	4.374	15.604	-23.933	-9.189	-8.171	-14.888	-1.677	-8.691	15.167	15.797	-4.535	-4.888	-15.701	-8.084	-14.799	0.000	-6.512
		P5.728_hp	32.675	1.765	1.607	12.646	17.405	-3.699	-2.941	-8.724	4.146	12.788	-1.780	-1.645	-12.761	-2.857	-8.622	6.512	0.000	12.823	
		P5.728_np	5.674	4.676	4.818	-5.626	-11.928	5.176	6.384	5.027	15.081	12.681	-1.572	-5.782	4.685	4.803	-5.738	6.457	5.211	15.152	12.823

Figure 57: Diebold-Mariano Test for price forecasts (DK2)

Area	Dates	Model 1	P4_182	P4_182_asinh	P4_182_hp	P4_364	P4_364_asinh	P4_364_hp	P4_728	P4_728_asinh	P4_728_hp	P5_182	P5_182_asinh	P5_182_hp	P5_364	P5_364_asinh	P5_364_hp	P5_728	P5_728_asinh	P5_728_hp			
DK2	2019.05.13-2020.05.12	P4.182	0.000	2.367	2.367	-9.207	-9.905	-6.646	-5.840	-0.018	1.075	1.585	2.356	4.099	2.385	2.370	0.263	-5.749	0.200	1.162	2.452		
		P4.182_asinh	-2.367	0.000	-0.682	-2.370	10.082	-10.180	-9.275	-1.555	-0.513	0.123	0.570	-2.320	0.357	0.079	-2.331	-9.178	-1.361	-0.409	0.174		
		P4.182_hp	-0.244	0.682	0.000	-2.349	-10.149	-2.957	-1.589	-0.491	0.143	0.589	-2.297	0.630	0.465	-2.310	-9.169	-1.345	-0.387	0.195	0.675		
		P4.182_zcp	0.207	2.370	2.349	0.000	-9.906	-6.635	-5.833	-0.013	1.078	1.589	2.367	0.443	2.387	2.374	0.337	-5.741	0.205	1.165	1.631		
		P4.364	9.905	10.086	10.072	9.908	0.000	3.391	4.512	12.910	10.458	9.805	13.510	9.823	10.042	10.040	9.828	13.177	10.525	9.628	13.597		
		P4.364_asinh	6.646	10.18	10.149	6.653	-3.391	0.000	10.994	7.538	11.236	10.288	9.306	10.665	10.126	10.108	6.617	10.565	7.785	11.350	10.327		
		P4.364_hp	5.840	9.277	9.257	5.833	-4.515	10.994	0.000	6.574	10.098	9.534	8.556	5.823	9.223	9.216	5.818	1.920	10.217	9.575	8.660		
		P4.728	0.018	1.555	1.539	0.013	12.910	-7.538	-6.574	0.000	1.653	2.185	8.048	0.047	1.564	1.553	0.037	-6.467	6.205	1.776	2.236		
		P4.728_asinh	-1.075	0.513	0.491	-1.075	-10.458	-11.235	-10.064	-1.654	-0.050	1.787	1.428	-1.054	-0.530	0.514	-1.054	-9.966	-1.364	-0.286	1.910	-1.450	
		P4.728_hp	-1.985	0.129	-0.143	-1.589	-9.805	-10.288	-9.534	-0.934	-2.185	-1.787	0.000	0.667	-1.555	-0.103	-0.118	-1.564	-0.942	-1.934	-1.502	1.494	
		P5.182	0.249	2.320	2.397	0.443	9.823	-6.630	-5.828	-0.047	1.045	1.555	2.310	0.000	2.351	2.335	-0.438	5.745	0.170	1.132	1.598		
		P5.182_asinh	2.385	-0.357	-0.830	-2.387	10.042	-10.126	-9.223	-1.584	-0.310	0.550	-2.851	0.000	-0.496	-2.362	-0.143	-1.373	-0.427	0.154	0.636		
		P5.182_hp	0.370	-0.270	-0.423	-2.371	-10.040	-10.108	-9.216	-1.559	-0.514	0.118	0.564	-2.348	0.496	0.000	-2.348	-0.138	-1.361	-0.411	0.169		
		P5.364	0.263	2.331	2.310	-0.337	-9.828	-6.617	-5.819	0.037	1.054	1.564	2.227	0.438	2.362	2.348	0.000	-5.735	1.030	1.141	1.607		
		P5.364_asinh	5.749	9.176	9.160	5.741	-4.607	-10.565	-1.920	-0.467	0.986	9.442	8.457	5.745	9.143	9.136	5.735	0.000	6.722	10.125	9.496	8.568	
		P5.364_hp	4.200	1.361	1.345	-2.025	-13.177	-7.785	-8.622	-4.285	1.366	1.934	7.346	1.077	1.373	1.361	-0.180	-6.722	0.000	1.493	1.988		
		P5.728	-1.162	0.409	0.387	-1.165	-10.525	-11.350	-10.217	-1.776	-2.836	1.502	2.97	-1.132	0.427	0.411	-1.141	-10.128	-1.490	0.000	1.643		
		P5.728_asinh	-0.167	-0.174	-0.195	-1.831	-9.828	-10.327	-9.575	-2.326	-1.910	-1.494	0.600	-1.598	-0.154	-0.169	-1.607	-0.496	-1.988	-1.643	0.000		
		P5.728_hp	-2.452	-0.656	-0.675	-2.463	-9.848	-10.346	-9.347	-8.401	-4.914	-0.000	-5.059	-5.437	-6.620	-3.036	-3.064	-8.492	7.218	-3.220	10.354	-1.549	
		P4.728_zcp	-7.754	1.485	1.309	-7.164	-11.526	-5.518	-4.860	-2.161	5.059	0.000	3.417	-6.872	-4.156	-1.247	-4.753	-7.380	-0.668	6.606	16.575		
		P4.728_asinh	-5.860	-3.341	-3.152	-1.883	-14.948	-9.347	-8.401	-4.914	-2.161	4.247	5.438	3.417	0.000	-4.977	0.724	0.909	-4.857	-0.477	5.072	6.230	5.092
		P4.728_hp	-7.754	1.485	1.309	-7.164	-11.526	-5.518	-4.860	-2.161	5.059	0.000	3.417	-6.872	-4.156	-1.247	-4.753	-7.380	-0.668	6.606	16.575		
		P4.728_zcp	-5.422	0.718	0.876	-5.332	-11.728	-2.048	-1.830	-2.475	5.438	3.417	0.000	-4.977	0.724	0.909	-4.857	-0.477	5.072	6.230	5.092		
		P4.728_asinh	-7.448	-0.904	-0.740	-7.353	-17.577	-4.684	-3.867	-11.404	3.320	0.668	-5.072	-7.027	-0.883	-0.869	-4.900	-2.862	0.000	4.504	2.288		
		P4.728_hp	-9.668	-4.186	-3.996	-9.601	-15.760	-10.617	-9.618	-6.012	-10.354	-6.406	-6.320	-9.363	-4.159	-3.932	-2.236	-8.528	-4.504	0.000	-3.662	-4.391	
		P5.728	-8.327	-2.695	-2.520	-8.239	-12.733	-7.121	-6.521	-3.784	1.549	18.575	-5.092	-7.962									

Area	Dates	Model 1	P4 182	P4 182 asinh hp	P4 182	P4 182 asinh hp	P4 364	P4 364 asinh hp	P4 728	P4 728 asinh hp	P4 728	P4 728 asinh hp	P5 182	P5 182 asinh hp	P5 364	P5 364 asinh hp	P5 728	P5 728 asinh hp				
DK2	2020.01.01-2020.05.12	P4.182	0.000	-10.694	-10.520	4.671	-1.651	-10.221	-10.109	-0.965	-6.738	5.996	0.711	4.100	-10.563	-10.405	5.658	-0.972	-0.709	-6.613	-5.888	0.954
		P4.182.asinh	10.694	0.000	3.714	10.839	7.346	-4.761	-4.601	6.429	-0.944	0.024	7.959	10.936	1.826	3.572	11.070	-4.420	6.688	-0.791	0.157	8.202
		P4.182.asinh-hp	10.520	-3.714	10.874	7.237	-4.921	-4.766	6.333	-1.056	0.089	7.871	10.962	-0.659	1.645	10.905	-4.585	6.592	-0.903	0.044	8.113	
		P4.182hp	-4.671	-10.839	-10.774	0.000	-1.802	-10.312	-10.200	-1.089	-8.819	-6.000	0.599	1.767	-10.707	-10.598	4.002	-10.069	-0.823	-6.694	-5.971	0.843
		P4.364	1.651	-7.348	-7.237	1.802	0.000	-12.905	-12.670	0.380	-6.748	5.823	2.495	1.908	-7.202	-7.106	2.045	-12.449	0.725	-6.588	-5.690	2.806
		P4.364.asinh	10.223	4.761	4.921	10.312	12.905	0.000	2.767	10.431	3.560	4.683	11.770	10.331	4.805	4.953	10.415	4.795	10.696	3.773	4.816	11.972
		P4.364.asinh-hp	10.105	4.601	4.761	10.200	12.670	-2.767	0.000	10.322	3.384	4.530	11.655	10.217	4.647	4.800	10.305	4.048	10.587	3.548	4.664	11.896
		P4.728	0.965	-6.424	-6.333	1.064	-0.384	-10.431	-10.322	0.000	-8.464	-7.410	13.528	1.167	-6.315	-6.230	1.273	-10.139	7.564	-8.252	-7.214	14.771
		P4.728.asinh	6.738	0.946	1.056	6.819	6.748	-3.560	-3.384	8.481	0.000	8.030	10.109	6.857	1.015	1.117	6.932	-3.190	8.783	3.528	8.499	10.387
		P4.728.asinh-hp	5.996	-0.024	0.099	6.050	5.826	-4.583	7.410	-8.050	0.000	9.159	6.122	0.054	0.157	6.199	-4.341	7.710	-6.487	3.071	9.419	
		P5.728hp	-0.711	-7.959	-8.711	-0.599	-2.467	-11.730	-11.655	-13.528	-10.150	-9.139	0.000	-7.840	-7.762	-0.388	-11.473	-11.236	-9.875	-8.933	7.028	
		P5.182	-4.100	-10.939	-10.762	-1.750	-1.908	-10.331	-10.217	-1.167	-6.857	6.122	0.480	0.000	-10.842	-10.682	4.256	-10.090	0.915	-6.735	-6.616	0.728
		P5.182.asinh	10.963	-1.820	0.659	10.707	7.202	-4.805	-4.647	6.318	-1.059	7.840	10.842	0.000	3.409	10.974	-4.473	6.574	-0.853	0.079	8.083	
		P5.182.asinh-hp	10.405	-3.572	-1.645	10.558	7.106	-4.953	-4.800	6.230	-1.117	-0.157	7.762	10.682	-3.409	0.000	10.823	-4.625	6.489	-0.966	-0.024	8.005
		P5.182hp	-5.656	-11.076	-10.905	-4.002	-2.026	-10.415	-10.305	-1.273	-6.938	-6.199	0.386	-4.262	-10.974	-10.823	0.000	-10.178	1.021	-6.810	-6.093	0.626
		P5.364asinh	9.972	4.420	4.581	10.000	12.449	-4.795	-4.048	10.138	3.190	4.341	11.473	10.090	4.473	4.625	10.178	0.000	10.428	3.361	4.484	11.722
		P5.728	0.709	-6.686	-6.592	0.824	-0.725	-10.696	-10.587	-7.563	-8.763	-7.710	11.234	0.915	-6.574	-6.489	1.021	-10.409	0.000	-8.561	-7.519	13.436
		P5.728.asinh	6.613	0.791	0.903	6.694	6.588	-3.723	-3.548	8.252	-3.528	6.467	9.875	6.735	0.863	0.966	6.810	-3.361	8.561	0.000	7.983	10.162
		P5.728.asinh-hp	5.888	-0.157	-0.644	5.971	5.690	-4.816	-4.664	7.214	-8.499	-3.071	8.933	6.016	-0.079	0.024	6.093	-4.484	7.519	-7.883	0.000	9.221
		P5.728hp	-0.954	-8.202	-8.113	-0.843	-2.806	-11.972	-11.896	-14.721	-10.367	-9.419	-7.028	-8.083	-8.005	-0.626	-11.722	-13.436	-10.162	-9.221		

Figure 60: Diebold-Mariano Test for price forecasts (DK2)

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