What does Submetering Data Show?

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IOT Analytics

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Agenda

IOT ANALYTICS

Overall Trends

Monthly Patterns

Heating only dips in July and August

Weekly Patterns

Increased entertainment electronics use during weekend?

Legend:
- Kitchen
- Laundry Room
- Heating
- Unmeasured

Y-axis: Watt Hours

X-axis: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday
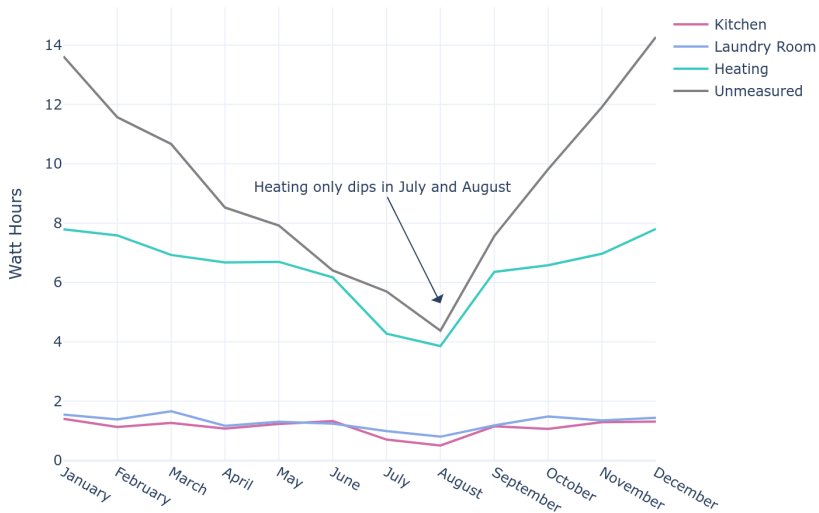
IOT ANALYTICS
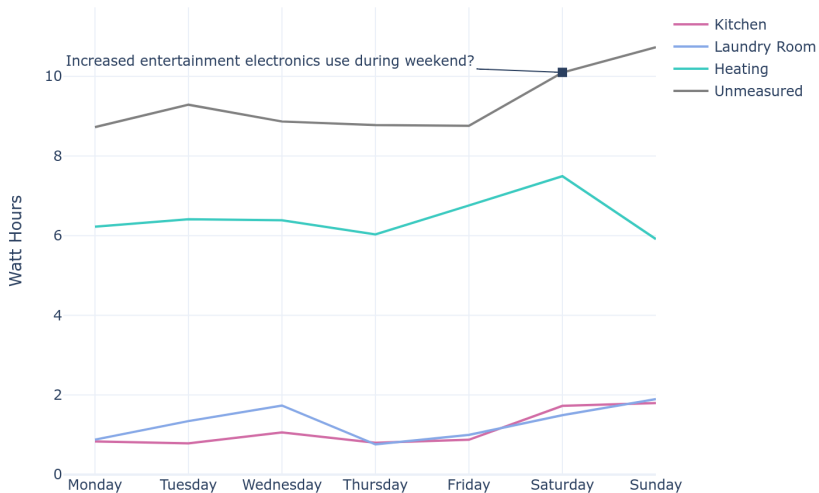
Daily Patterns
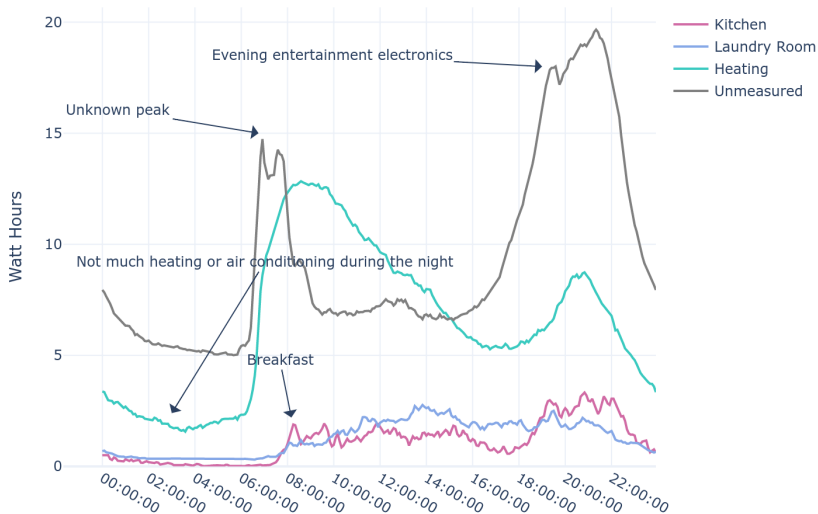
A Typical Summer Day

Christmas Holiday

Hour Level Model - Predicting Hours for One Month

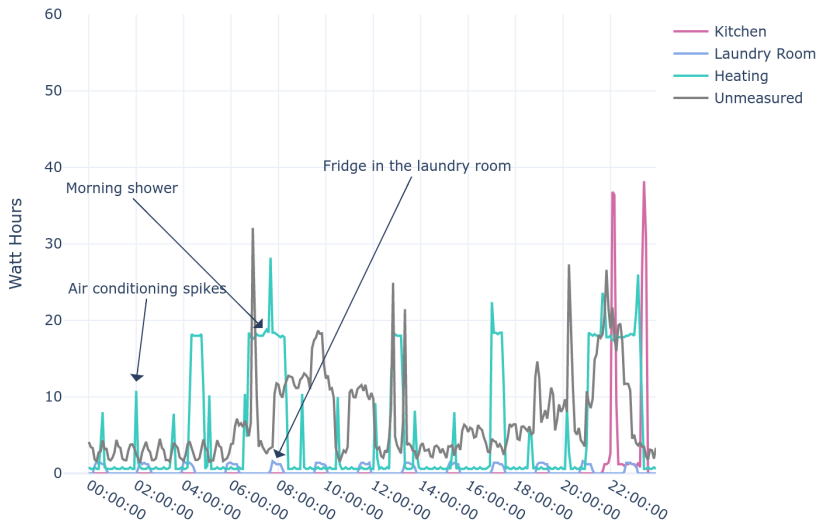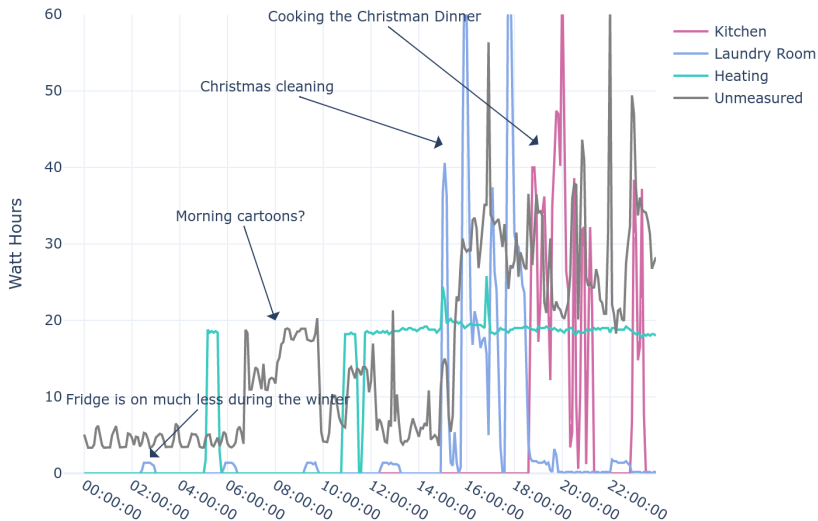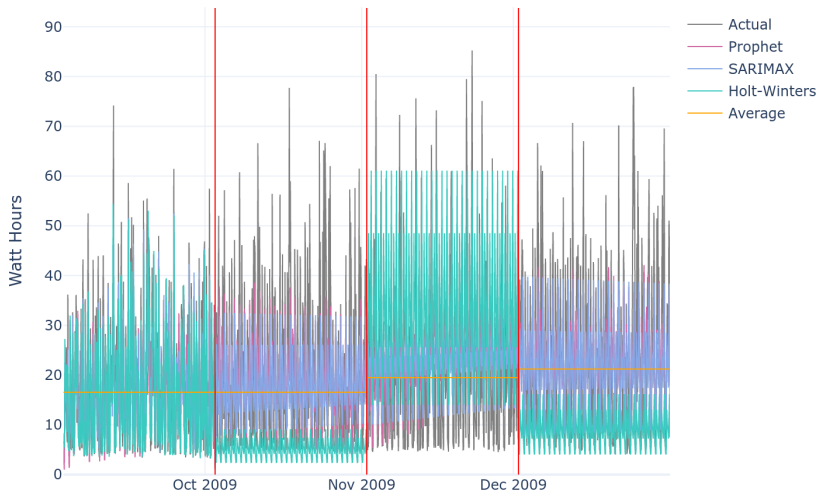# Hour Level Model - Predicting Hours for One Month

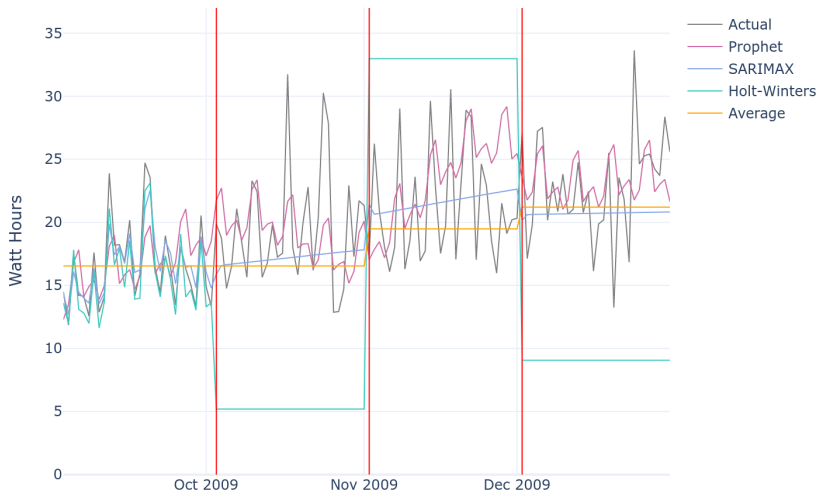| Type	Metric	Prophet	SARIMAX	Holt-Winters	Average
Insample	MSE	96.66	67.5	81.26	166.88
Test 1	MSE	138.16	152.35	385.51	220.05
Test 2	MSE	153.77	149.7	298.82	247.68
Test 3	MSE	166.13	155.6	383.21	250.37
Insample	MAE	7.42	5.95	6.1	10.84
Test 1	MAE	8.84	8.9	14.32	11.89
Test 2	MAE	9.59	9.04	14.59	12.48
Test 3	MAE	10.1	9.3	14.4	12.9

Hour Level Model - Predicting Days for One Month

Hour Level Model - Predicting Days for One Month

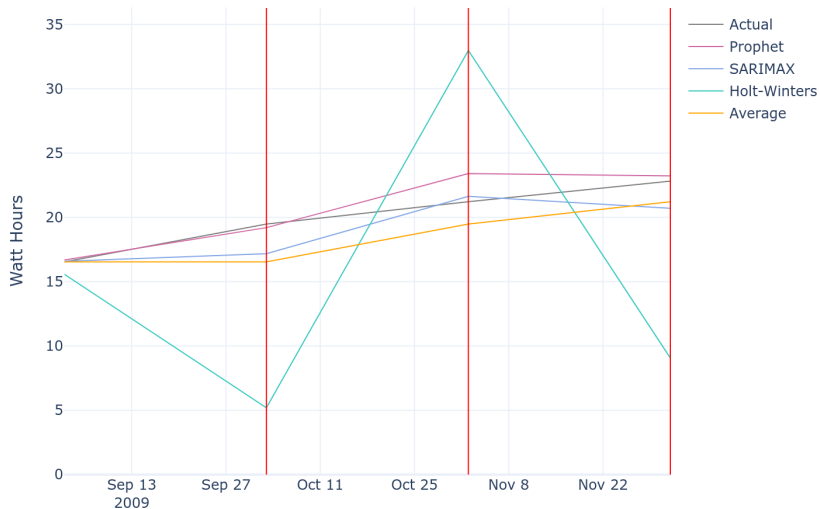| Type	Metric	Prophet	SARIMAX	Holt-Winters	Average
Insample	MSE	8.52	2.07	1.73	11.13
Test 1	MSE	17.12	25.54	224.48	29.11
Test 2	MSE	24.92	20.2	158.33	22.78
Test 3	MSE	17.77	21.19	205.98	19.27
Insample	MAE	2.39	1.1	1.08	2.65
Test 1	MAE	3.18	3.65	14.28	3.86
Test 2	MAE	4.26	3.88	11.77	3.62
Test 3	MAE	2.91	3.6	13.76	3.46

Hour Level Model - Predicting for One Month

Hour Level Model - Predicting for One Month

Type	Metric	Prophet	SARIMAX	Holt-Winters	Average
Insample	MSE	0.02	0	0.94	0
Test 1	MSE	0.08	5.29	204.01	8.65
Test 2	MSE	4.8	0.18	138.55	3
Test 3	MSE	0.17	4.48	189.3	2.59
Insample	MAE	0.15	0.05	0.97	0
Test 1	MAE	0.28	2.3	14.28	2.94
Test 2	MAE	2.19	0.43	11.77	1.73
Test 3	MAE	0.41	2.12	13.76	1.61

Day Level Model - Predicting Days for One Month
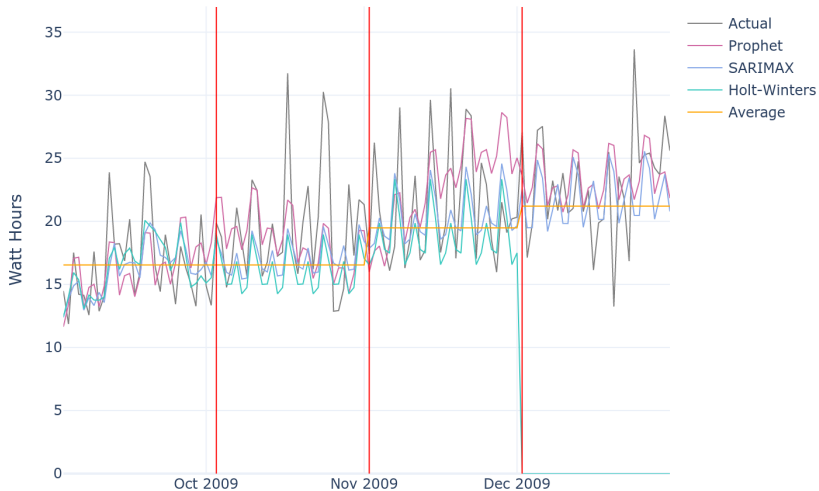
Day Level Model - Predicting Days for One Month

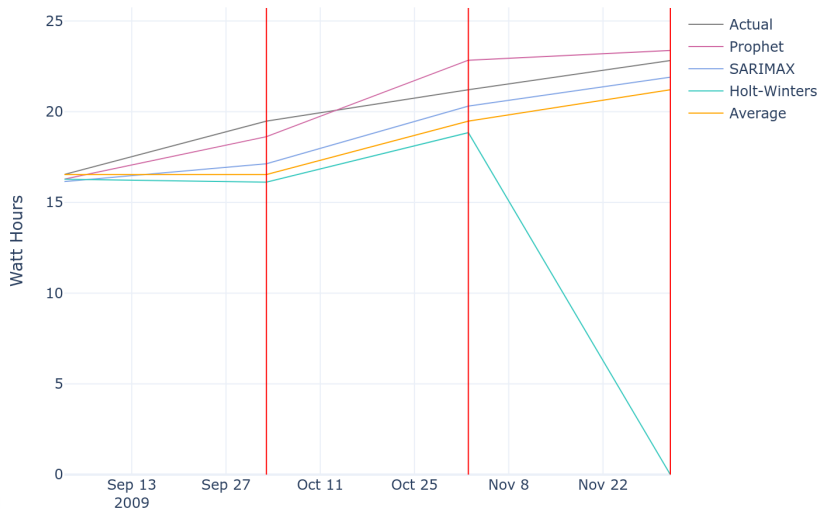| Type	Metric	Prophet	SARIMAX	Holt-Winters	Average
Insample	MSE	8.43	8.03	6.95	11.13
Test 1	MSE	16.76	19.63	24.76	29.11
Test 2	MSE	21.99	15.14	19.32	22.78
Test 3	MSE	17.92	19.19	537.5	19.27
Insample	MAE	2.4	2.3	2.08	2.65
Test 1	MAE	3.01	3.23	3.8	3.86
Test 2	MAE	3.99	3.01	3.24	3.62
Test 3	MAE	2.92	3.15	22.82	3.46

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Day Level Model - Predicting for One Month

Day Level Model - Predicting for One Month

Type	Metric	Prophet	SARIMAX	Holt-Winters	Average
Insample	MSE	0.07	0.15	0.07	0
Test 1	MSE	0.74	5.51	11.29	8.65
Test 2	MSE	2.64	0.82	5.6	3
Test 3	MSE	0.31	0.85	520.82	2.59
Insample	MAE	0.26	0.39	0.26	0
Test 1	MAE	0.86	2.35	3.36	2.94
Test 2	MAE	1.63	0.91	2.37	1.73
Test 3	MAE	0.56	0.92	22.82	1.61

Conclusions

1. Privacy!
   - Individual days show an intimate picture of how people live their lives
   - Even aggregated measures show private information
2. Security! $\Rightarrow$ A burglar could see when somebody is at home
3. Categorizing patterns with a machine model would probably be possible, but would require lots of manual effort, because we would have to label the observations ourselves
4. Hour level hard to predict
5. Need to pick some level of interest for the models as they perform best when used in the same level that they were trained

Questions?