Renewable Energy Forecast Project

Member: Eagle Ying, Susan Yin, Jenny Yue

Agenda

- Project background
- Data preparation
- Exploratory Data Analysis
- Models
- Final model and predictions

Project background

- Climate change is endangering our life
- Finding reliable renewable energy becomes a crucial step
- Rising of wind farms
- Our client: utility company

Data Preparation

- Impute values (na.interpolation)
- Aggregation & Time Index
- Time series object & plot

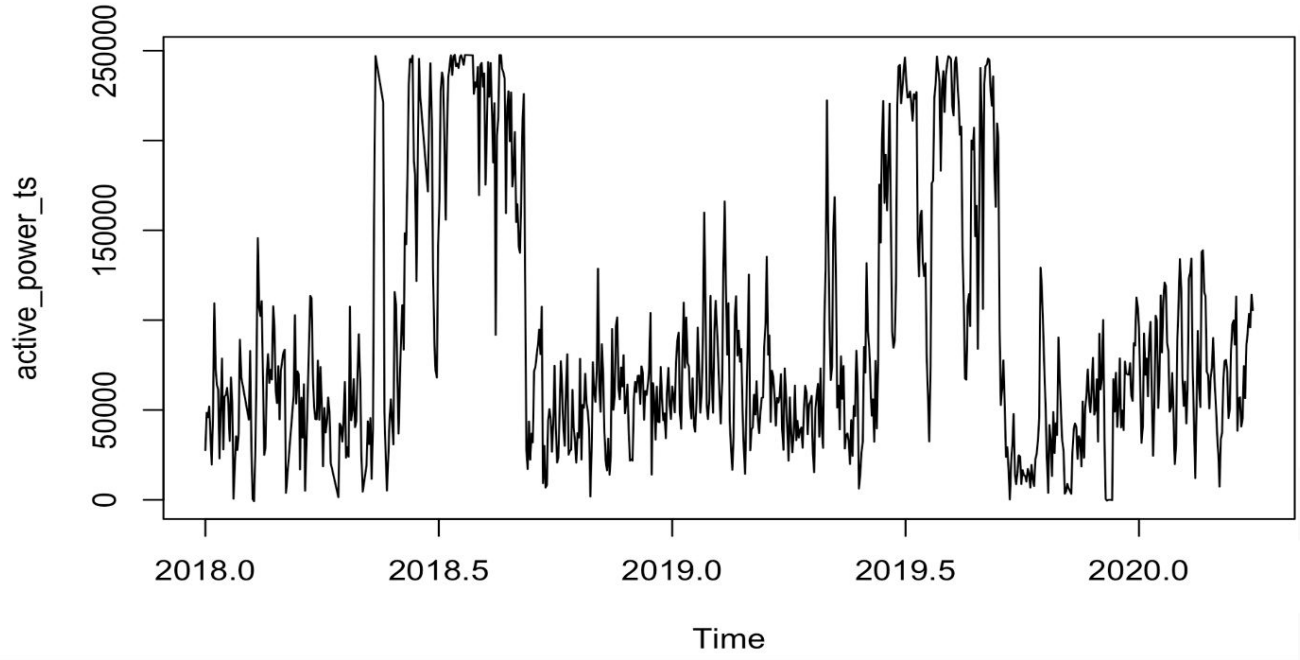
year <dbl>	month <dbl>	day <dbl>	date <S3: POSIXct>	active_power <dbl>	ambient_temperature <dbl>
2018	1	1	2018-01-01 00:00:00	-5.357727	23.14873
2018	1	1	2018-01-01 00:10:00	-5.822360	23.03975
2018	1	1	2018-01-01 00:20:00	-5.279409	22.94870
2018	1	1	2018-01-01 00:30:00	-4.648054	22.96685
2018	1	1	2018-01-01 00:40:00	-4.684632	22.93652
2018	1	1	2018-01-01 00:50:00	-4.756408	22.92078

Aggregation & Time Index

- Time Index: daily
- Sum: active_power
- Mean: ambient_temperature, wind_direction, wind_speed

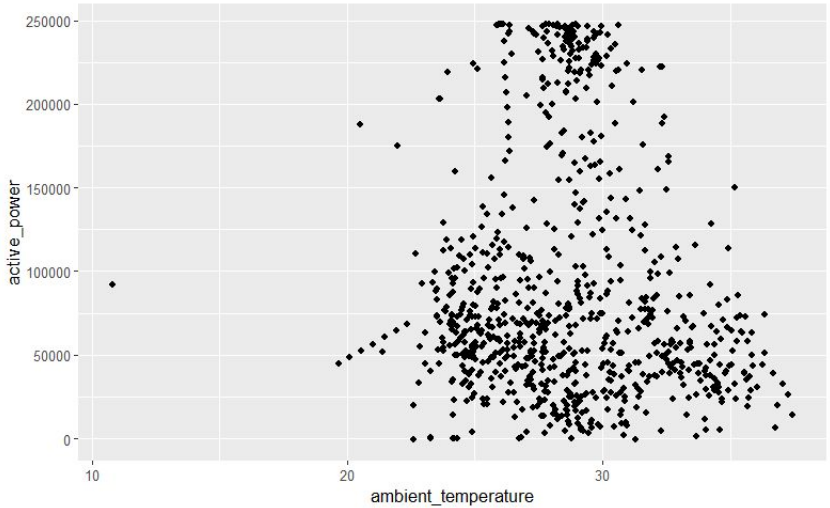
year <dbl>	month <dbl>	day <dbl>	active_power <dbl>	ambient_temperature <dbl>	wind_direction <dbl>	wind_speed <dbl>
2018	1	1	27570.75	26.51846	281.5338	3.877159
2018	1	2	48501.81	25.64296	273.0350	4.666082
2018	1	3	45904.82	25.50581	275.8649	4.525500
2018	1	4	51965.39	24.94145	284.9853	5.064239
2018	1	5	34608.72	24.63629	280.6632	4.423846
2018	1	6	19547.61	22.57549	312.1341	3.813356

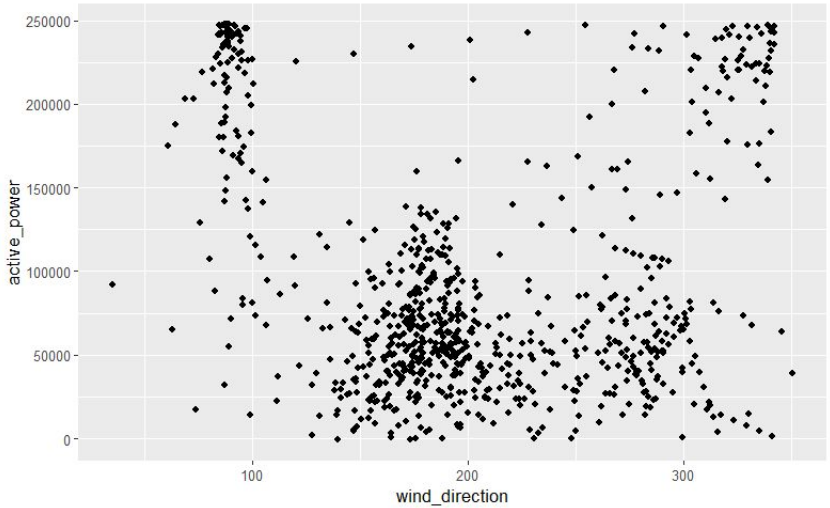
Time Series



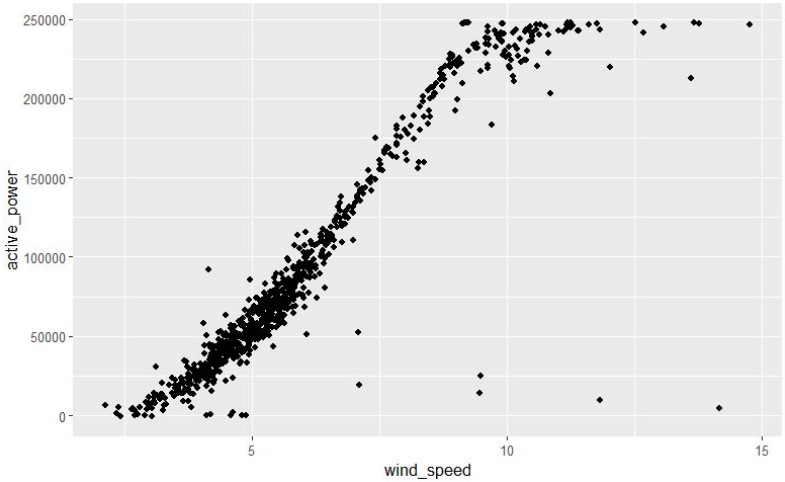
active_power <dbl>
27570.7490
48501.8066
45904.8192
51965.3897
34608.7212
19547.6142
51213.1585
109448.1129
73036.1857
63902.4295

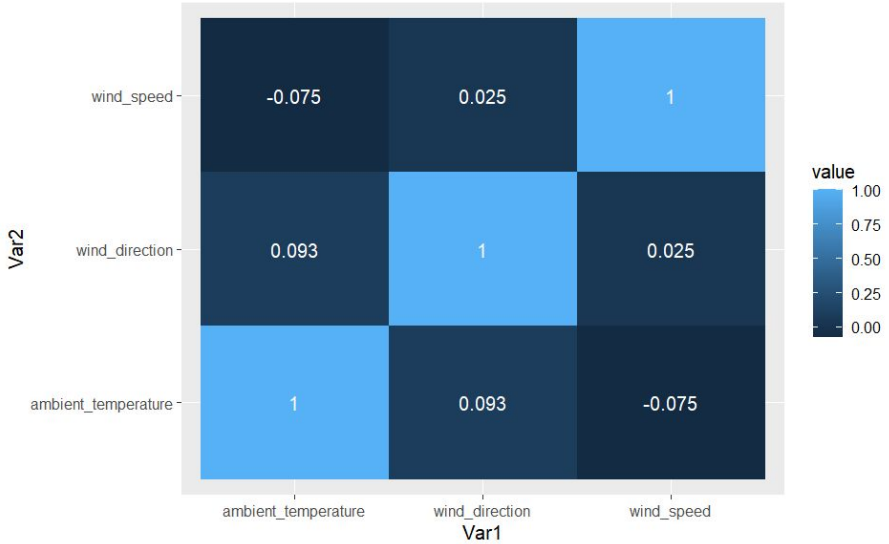
Exploratory Analysis





Exploratory Analysis





White noise

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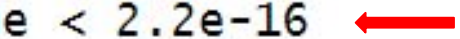
        Box-Ljung test

data:  active_power_ts
X-squared = 3741.7, df = 8, p-value < 2.2e-16
```



Stationarity

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 57.76974   12.27628   4.706 2.97e-06 ***
z.lag.1     -0.09046    0.01546  -5.849 7.14e-09 ***
z.diff.lag  -0.08069    0.03490  -2.312    0.021 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 212.3 on 815 degrees of freedom
Multiple R-squared:  0.05547,   Adjusted R-squared:  0.05315
F-statistic: 23.93 on 2 and 815 DF,  p-value: 7.966e-11
```

Modeling Method

1. **Explore Active Power Times Series Only**

- Seasonal Exponential Smoothing
- Auto.arima without Intervention

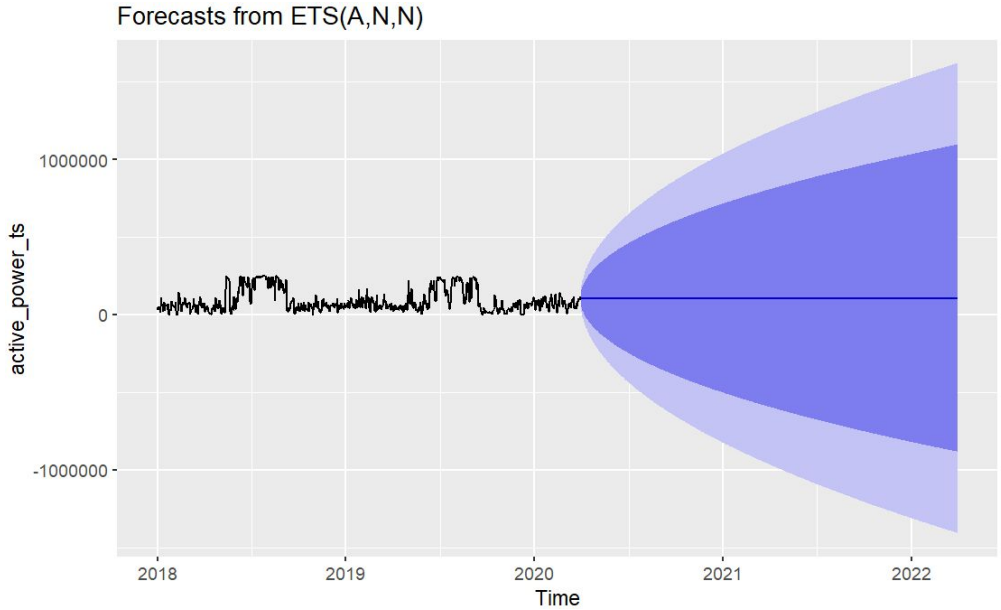
2. **Time Series Regression & Intervention**

- Explore p,d,q
- auto. arima with Intervention

Seasonal Exponential Smoothing Model

```
Training set error measures:
                    ME     RMSE      MAE  MPE MAPE      MASE        ACF1
Training set 74.1439 32242.08 23349.82 -Inf  Inf 0.5370699 0.01592923
```

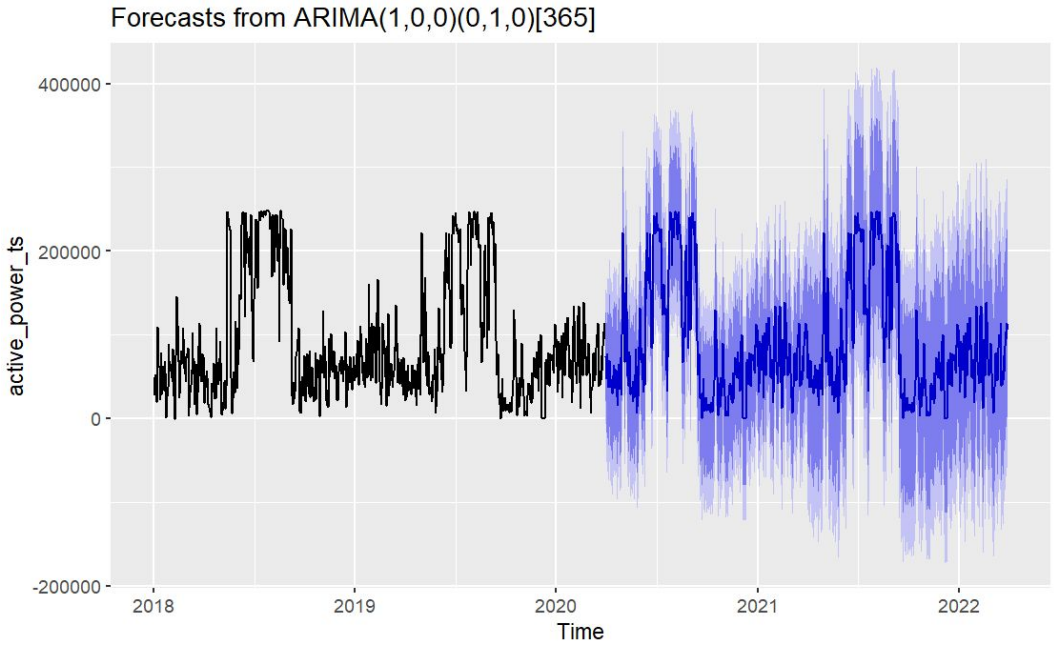
RMSE: 32242



Auto.arima without Intervention

```
Training set error measures:
                    ME     RMSE      MAE MPE MAPE      MASE        ACF1
Training set -487.6294 30628.84 17636.59 NaN  Inf 0.4056599 0.02762721
```

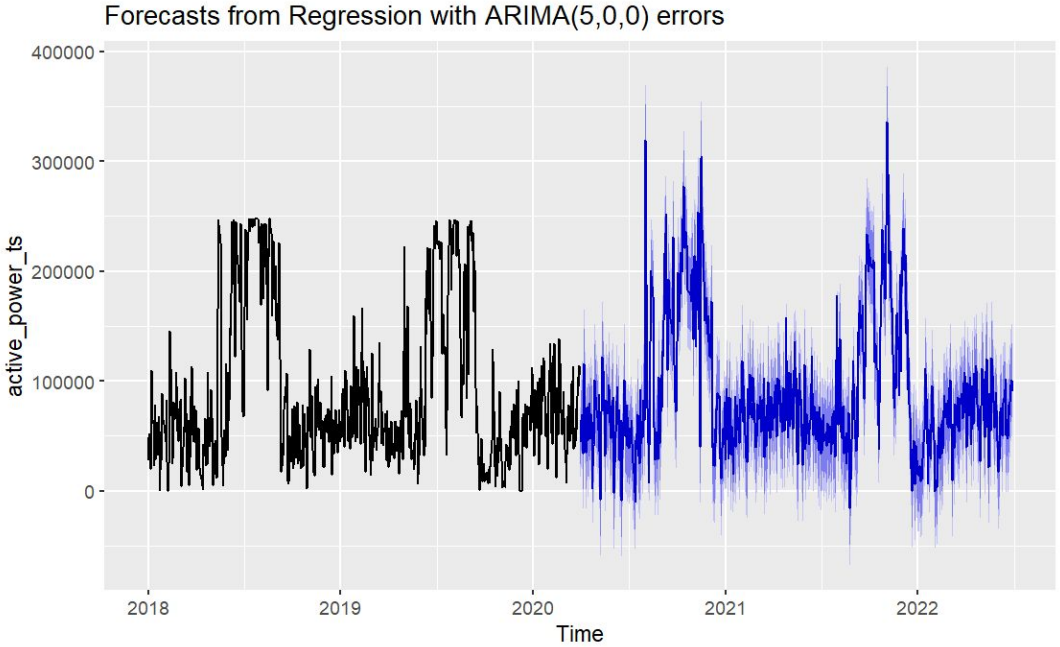
RMSE: 30628



Time Series Regression - Explore p, d, q (Final Model)

```
Training set error measures:
                    ME     RMSE      MAE  MPE MAPE      MASE         ACF1
Training set 3.031391 15870.51 10250.08 -Inf  Inf 0.2357625 0.002777523
```

RMSE: 15870

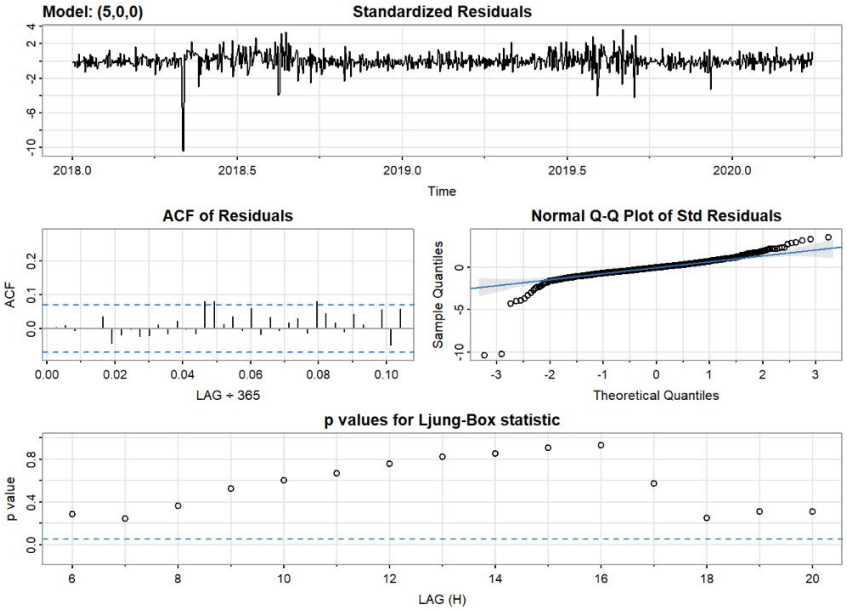


Time Series Regression - ARIMA(5,0,0)

	Point Forecast <dbl>	Lo 80 <dbl>	Hi 80 <dbl>	Lo 95 <dbl>	Hi 95 <dbl>
2020.2466	44205.7417	23779.48782	64632.00	12966.4822	75445.00
2020.2493	64354.8817	36788.49637	91921.27	22195.7335	106514.03
2020.2521	56360.7719	25823.38168	86898.16	9657.8638	103063.68
2020.2548	69303.4110	37158.79067	101448.03	20142.4565	118464.37
2020.2575	51329.3116	18859.74017	83798.88	1671.3873	100987.24

$ttable

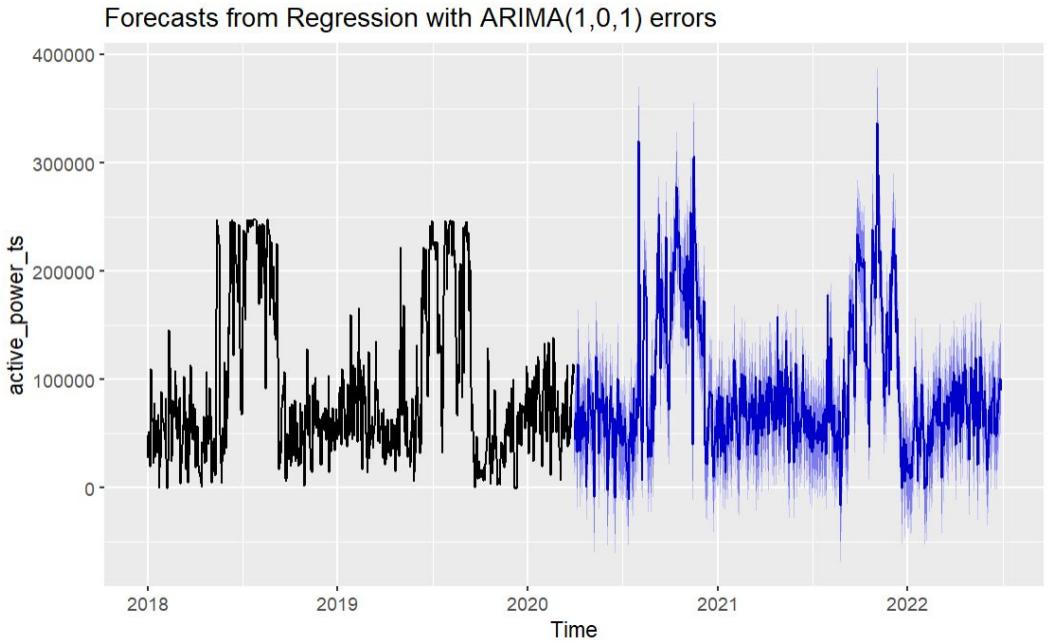
	Estimate	SE	t.value	p.value
ar1	0.9063	0.0344	26.3073	0.0000
ar2	-0.1781	0.0467	-3.8155	0.0001
ar3	0.0698	0.0468	1.4931	0.1358
ar4	-0.1697	0.0465	-3.6481	0.0003
ar5	0.1571	0.0345	4.5508	0.0000
intercept	-75070.6765	4320.0039	-17.3775	0.0000
wind_speed	27806.9496	582.3119	47.7527	0.0000



Auto.arima with Intervention

```
Training set error measures:
                    ME     RMSE      MAE  MPE MAPE      MASE          ACF1
Training set 7.072441 16073.93 10296.59 -Inf  Inf 0.2368323 -0.0006827484
```

RMSE: 16074



Conclusions

In the future	Amount of Power
2020/3/31	44206
2020/4/1	64355
2020/4/2	56360
2020/4/3	69303
2020/4/4	51329