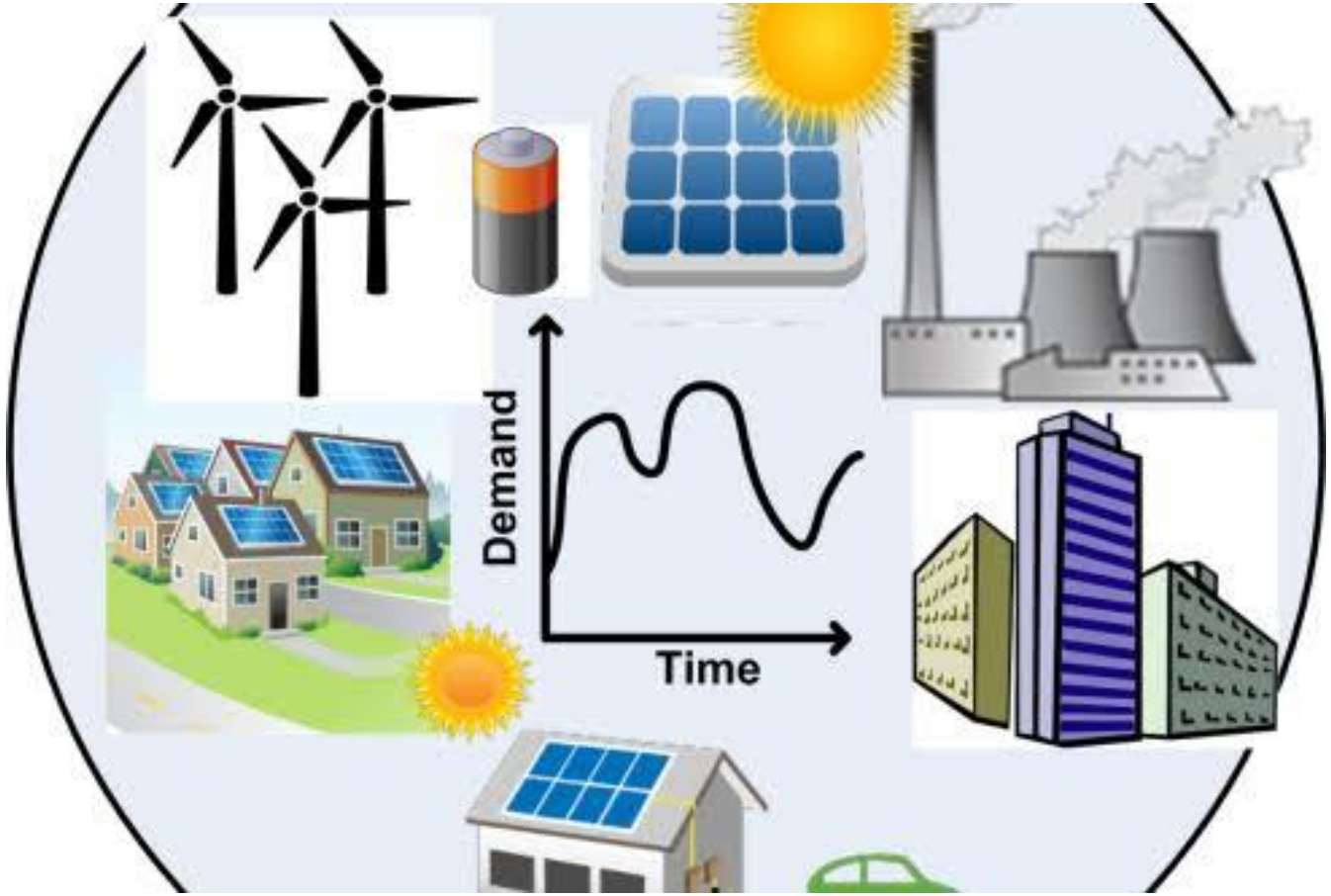
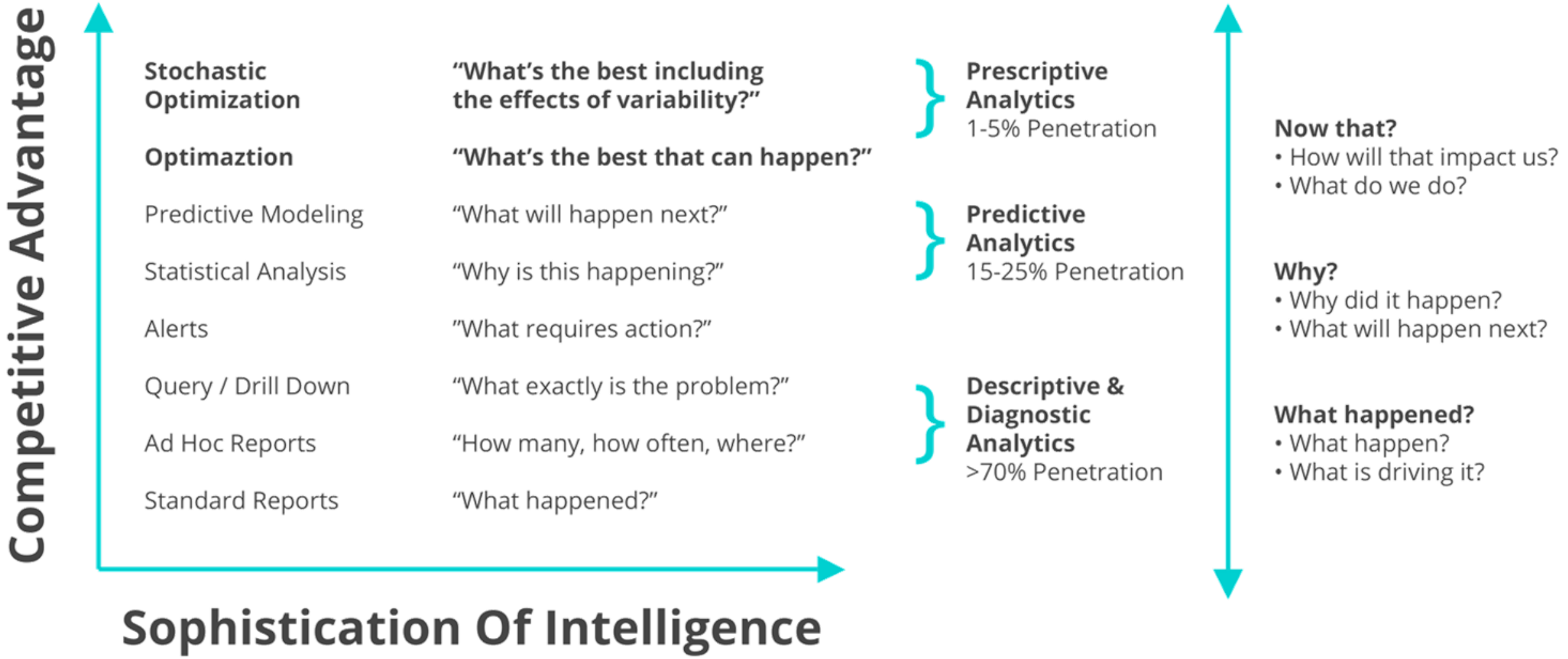
4. 에너지 데이터 분석 실습



박경규

데이터 분석의 POWER

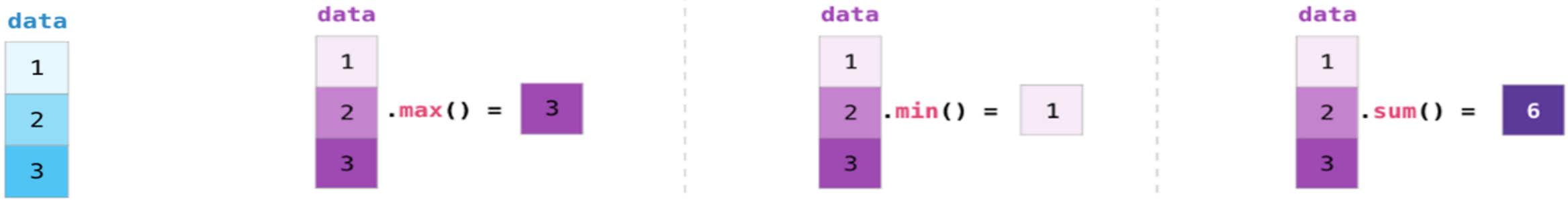


Source: Competing On Analystics: The New Science Of Winning (Davenport / Harris): Gartner

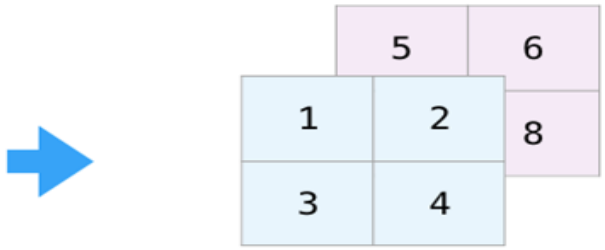
넘파이(Numpy)

NumPy(Numerical Python)는 데이터 분석을 포함해 수학과 과학연산을 위한 파이썬 기본 패키지로 고성능의 다차원 배열 객체와 다양한 객체에 대해 고속 연산을 가능하게 합니다.

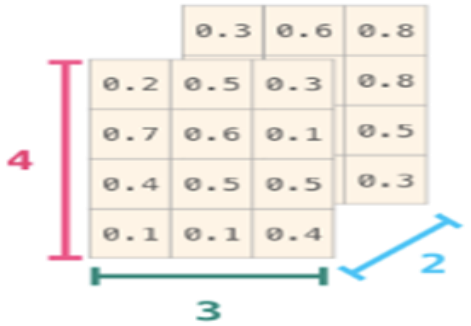
```
data = np.array([1,2,3])
```




```
np.array([ [[1,2],[3,4]],
           [[5,6],[7,8]] ])
```




```
np.random.random((4,3,2))
```



$$MeanSquareError = \frac{1}{n}\sum_{i=1}^{n}(Y\_prediction_i - Y_i)^2$$

```
error = (1/n) * np.sum(np.square(predictions - labels))
```

넘파이(Numpy)

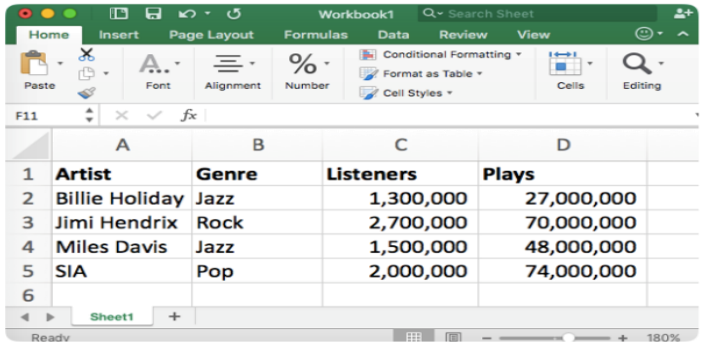
```
import numpy as np
lst = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
arr = np.array(lst)
arr
[Out] array([ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10])
arr.mean()
[Out] 5.5
print('Mean:', arr.mean())
print('Median:', np.median(arr))
print('Range (Max - min):', np.ptp(arr))
print('Standard deviation:', arr.std())
print('80th percentile:', np.percentile(arr, 80))
print('0.2-quantile:', np.quantile(arr, 0.2))
```

```
[Out]
Mean: 5.5
Median: 5.5
Range (Max - min): 9
Standard deviation: 2.87228132323
80th percentile: 8.2
0.2-quantile: 2.8000000000000003
```

판다스(Pandas)

Pandas는 데이타 분석을 위해 널리 사용되는 파이썬 라이브러리 패키지입니다.
데이터프레임 자료구조를 사용하여, 데이터 분석에 있어 높은 수준의 성능을 발휘합니다.

music.csv



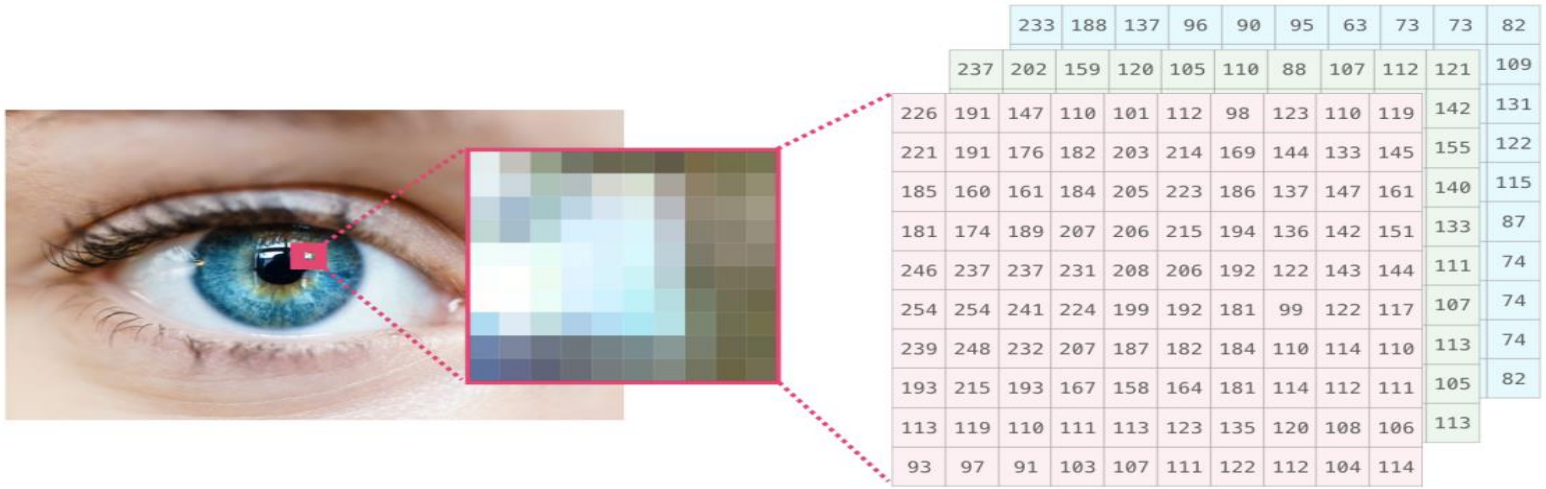
	A	B	C	D
1	Artist	Genre	Listeners	Plays
2	Billie Holiday	Jazz	1,300,000	27,000,000
3	Jimi Hendrix	Rock	2,700,000	70,000,000
4	Miles Davis	Jazz	1,500,000	48,000,000
5	SIA	Pop	2,000,000	74,000,000
6				

```
pandas.read_csv('music.csv')
```

	Artist	Genre	Listeners	Plays
0	Billie Holiday	Jazz	1,300,000	27,000,000
1	Jimi Hendrix	Rock	2,700,000	70,000,000
2	Miles Davis	Jazz	1,500,000	48,000,000
3	SIA	Pop	2,000,000	74,000,000

```
df['Avg Plays'] = df['Plays']/df['Listeners']
```

	Artist	Genre	Listeners	Plays	Avg Plays
0	Billie Holiday	Jazz	1,300,000	27,000,000	20
1	Jimi Hendrix	Rock	2,700,000	70,000,000	25
2	Miles Davis	Jazz	1,500,000	48,000,000	32
3	SIA	Pop	2,000,000	74,000,000	37



http://jalammar.github.io/gentle-visual-intro-to-data-analysis-python-pandas/

판다스(Pandas)

■ Pandas 라이브러리 임포트

```
import pandas as pd
```

■ 데이터프레임 생성

```
dates = pd.date_range('20220501', periods=31)
data = np.random.randint(0,100,(31,3))
df = pd.DataFrame(data=data, index=dates,
                  columns=['power_usage','gas_usage','water_usage'])
```

■ 데이터 확인

```
df.head()
```

	power_usage	gas_usage	water_usage
2022-05-01	86	98	84
2022-05-02	70	31	88
2022-05-03	0	29	51
2022-05-04	32	77	75
2022-05-05	57	48	17

```
df.tail()
```

	power_usage	gas_usage	water_usage
2022-05-27	90	84	63
2022-05-28	39	33	29
2022-05-29	5	77	72
2022-05-30	42	73	8
2022-05-31	54	27	3

판다스(Pandas)

■ 데이터프레임(DataFrame)

컬럼명(Column Names)

	power_usage	gas_usage	water_usage
2022-05-01	86	98	84
2022-05-02	70	31	88
2022-05-03	0	29	51
2022-05-04	32	77	75
2022-05-05	57	48	17

인덱스
(Index)

데이터

판다스(Pandas)

■ 자료구조 파악

df.info()

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 31 entries, 2020-01-01 to 2020-01-31
Freq: D
Data columns (total 3 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   power_usage  31 non-null     int64
 1   gas_usage    31 non-null     int64
 2   water_usage  31 non-null     int64
dtypes: int64(3)
memory usage: 992.0 bytes
```

■ 데이터 타입 확인

df.dtypes

```
power_usage     int64
gas_usage       int64
water_usage     int64
dtype: object
```

■ Null 데이터 확인

df.isnull().sum()

```
power_usage     0
gas_usage       0
water_usage     0
dtype: int64
```

판다스(Pandas)

■ 통계 정보

df.describe()

	power_usage	gas_usage	water_usage
count	31.000000	31.000000	31.000000
mean	45.161290	52.193548	52.161290
std	26.669704	31.679036	30.625803
min	3.000000	4.000000	0.000000
25%	29.000000	22.500000	18.500000
50%	41.000000	54.000000	57.000000
75%	61.500000	84.000000	76.000000
max	97.000000	99.000000	99.000000

■ 데이터 상관관계 분석

df.corr()

	power_usage	gas_usage	water_usage
power_usage	1.000000	-0.187838	0.073957
gas_usage	-0.187838	1.000000	0.007285
water_usage	0.073957	0.007285	1.000000

판다스(Pandas)

■ 새 컬럼 생성하기

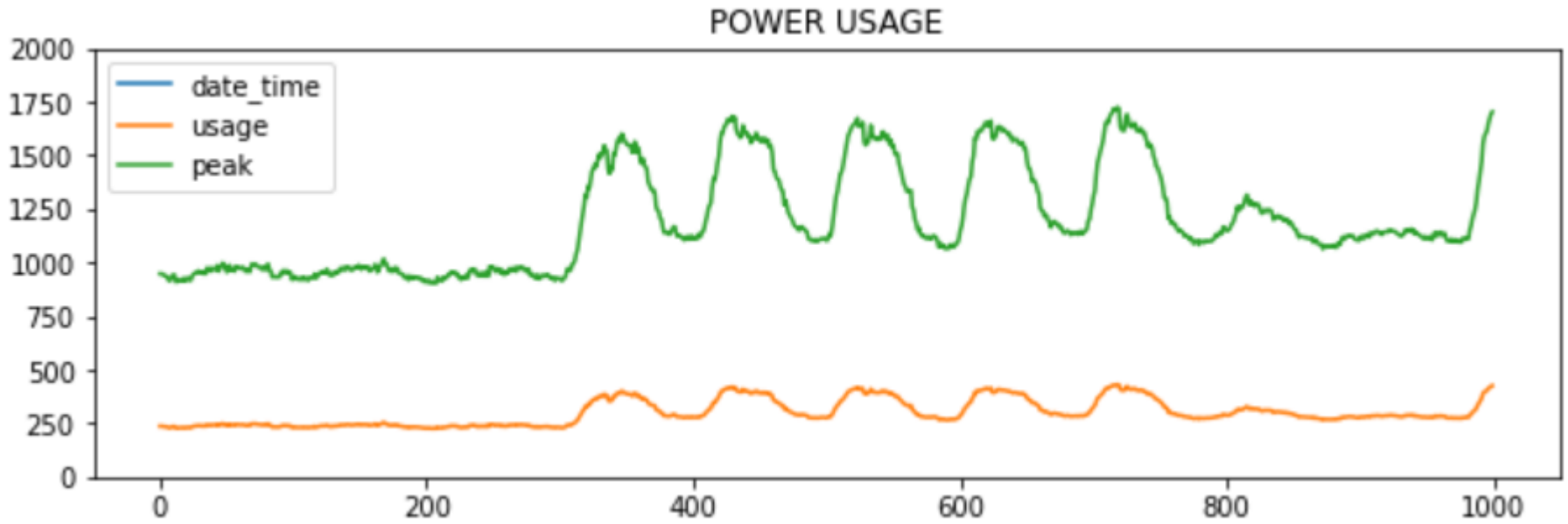
```
df['energy_usage'] = df['power_usage'] + df['gas_usage']
df['date'] = pd.to_datetime(df.index, format= '%Y-%m-%d')
df['day_of_week'] = df['date'].dt.day_name()
print(df)
```

	power_usage	gas_usage	water_usage	energy_usage	date	day_of_week
2020-01-01	95	86	64	181	2020-01-01	Wednesday
2020-01-02	31	82	2	113	2020-01-02	Thursday
2020-01-03	77	16	55	93	2020-01-03	Friday
2020-01-04	43	4	0	47	2020-01-04	Saturday
2020-01-05	44	79	57	123	2020-01-05	Sunday
2020-01-06	27	63	52	90	2020-01-06	Monday
2020-01-07	45	33	16	78	2020-01-07	Tuesday

판다스(Pandas)

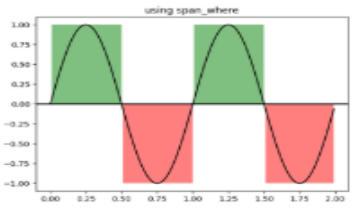
■ 파일에서 데이터를 로드하는 방법

```
# df_energy = pd.read_csv('data.csv')
df_energy = pd.read_csv(
'https://raw.githubusercontent.com/kgpark88/energy-bigdata-analysis/master/data.csv')

df_energy.plot(title='POWER USAGE', figsize=(10, 3), ylim=(0,2000))

plt.show()
```

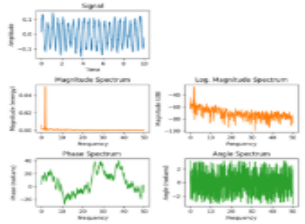


맷플롯립(Matplotlib)

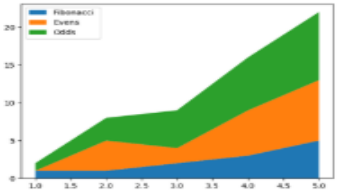
파이썬에서 데이터를 차트나 플롯(Plot)으로 그려주는 라이브러리 패키지로서 가장 많이 사용되는 데이타 시각화(Data Visualization) 패키지입니다.



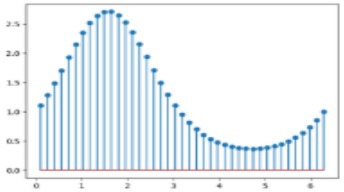
Using span_where



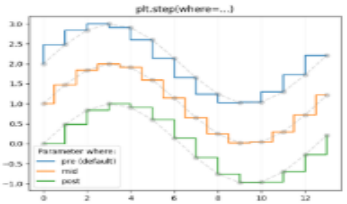
Spectrum Representations



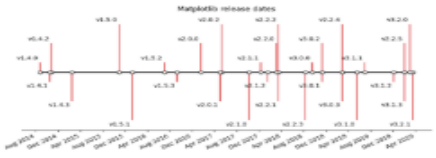
Stackplot Demo



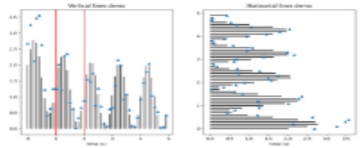
Stem Plot



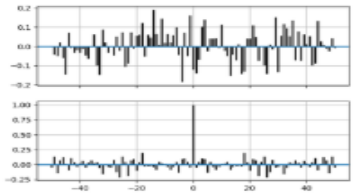
Step Demo



Creating a timeline with lines, dates, and text



hlines and vlines



Cross- and Auto-Correlation Demo

https://matplotlib.org/gallery/index.html

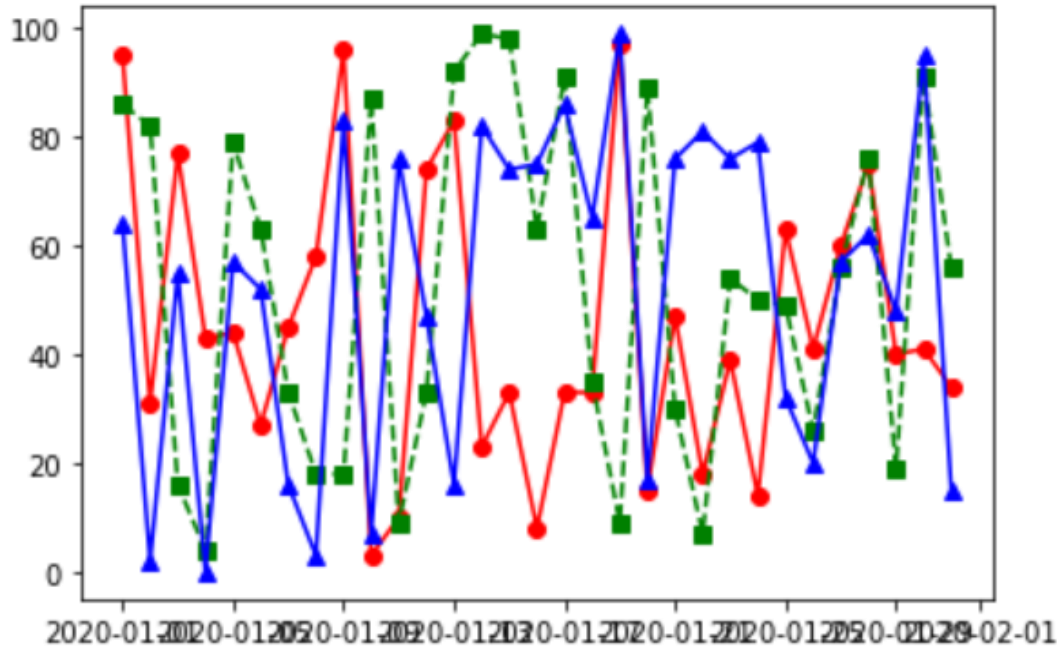
맷플롯립(Matplotlib)

■ 라이브러리 임포트

```
import matplotlib.pyplot as plt
```

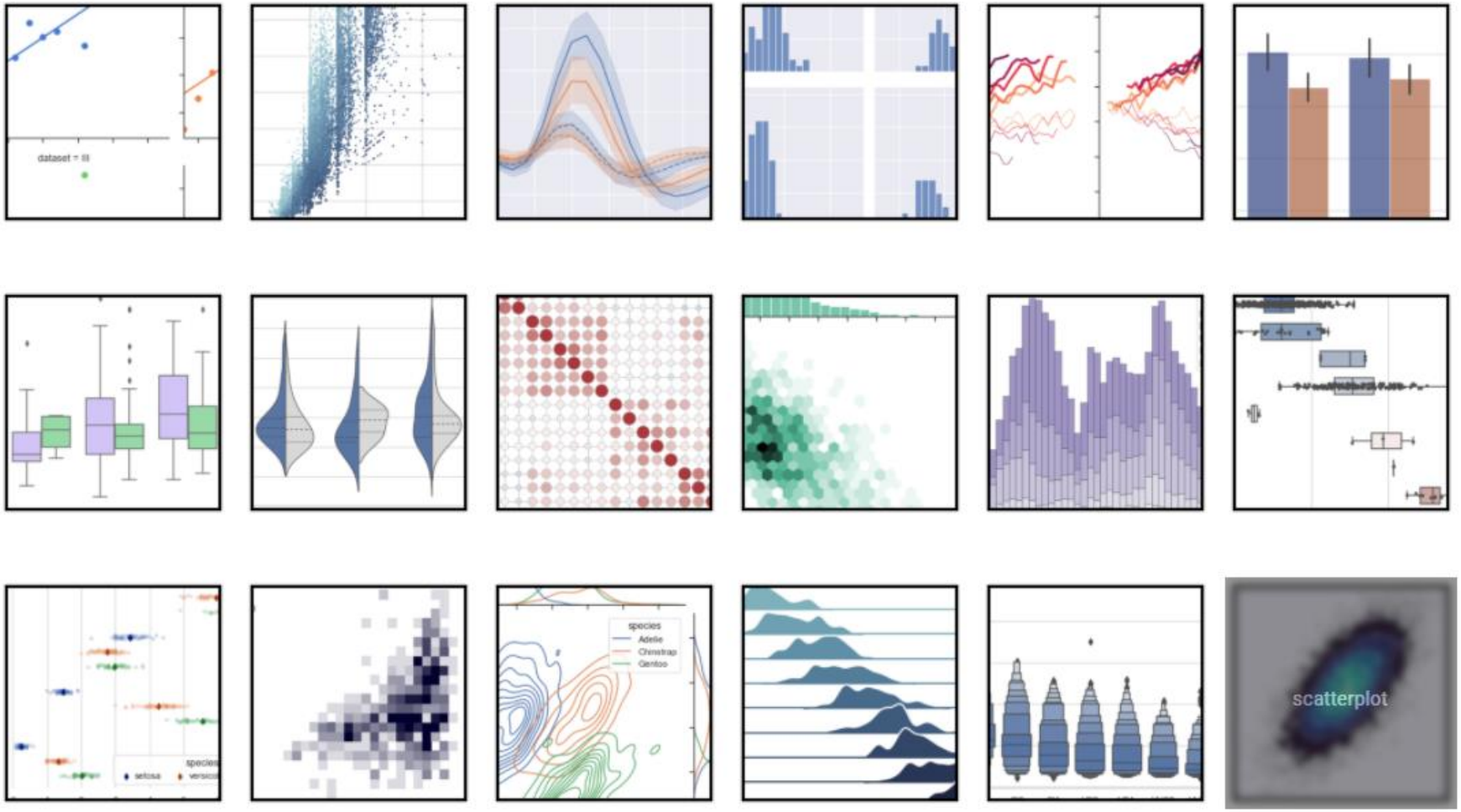
■ 선 그래프

```
plt.plot(df['power_usage'], 'ro-',
         df['gas_usage'], 'gs--',
         df['water_usage'], 'b^-')
plt.show()
```



씨본(Seaborn)

Matplotlib을 기반으로 다양한 색상 테마와 통계용 차트 등의 기능을 추가한 시각화 패키지입니다.



https://seaborn.pydata.org/examples/index.html

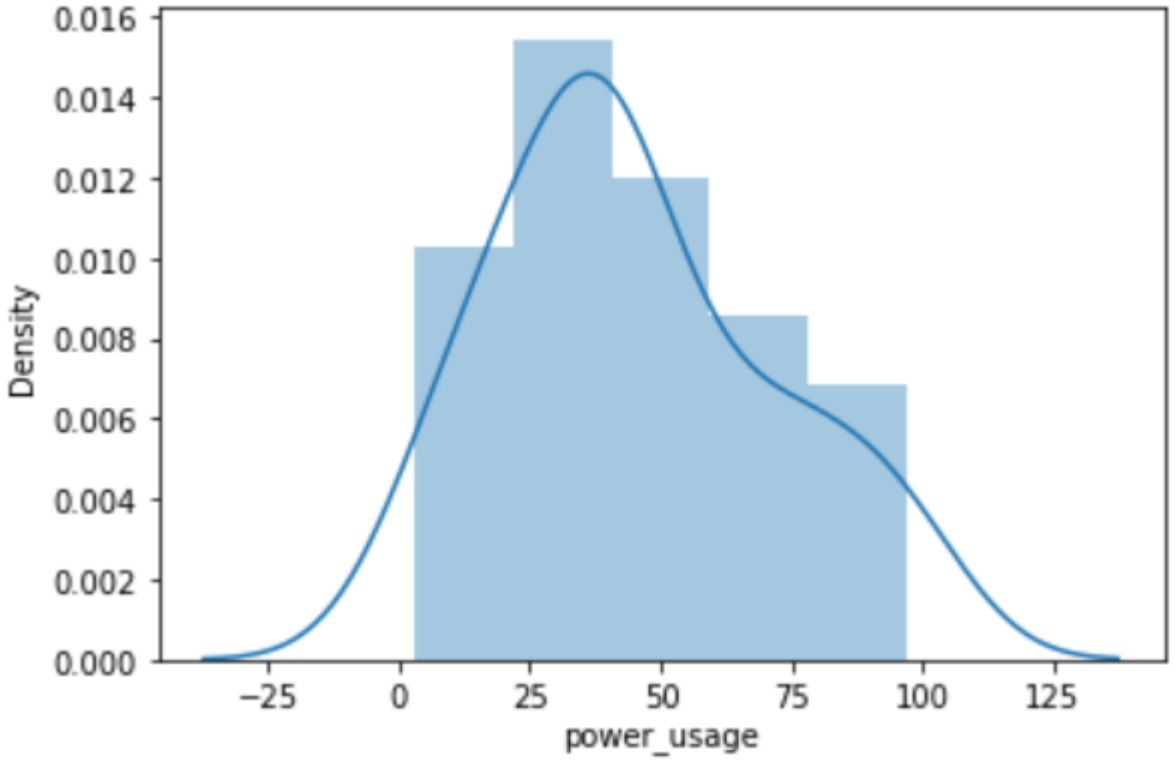
씨본(Seaborn)

■ 라이브러리 임포트

```
import seaborn as sns
```

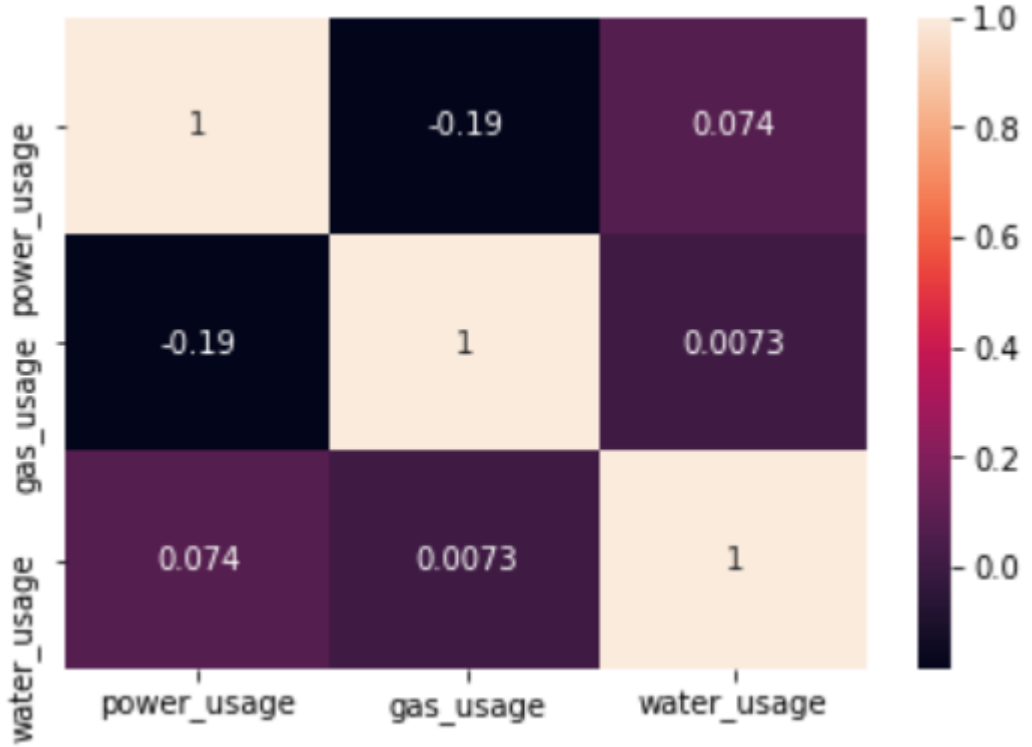
■ 분포 플롯

```
sns.distplot(df['power usage'])
```



■ 히트맵(상관관계)

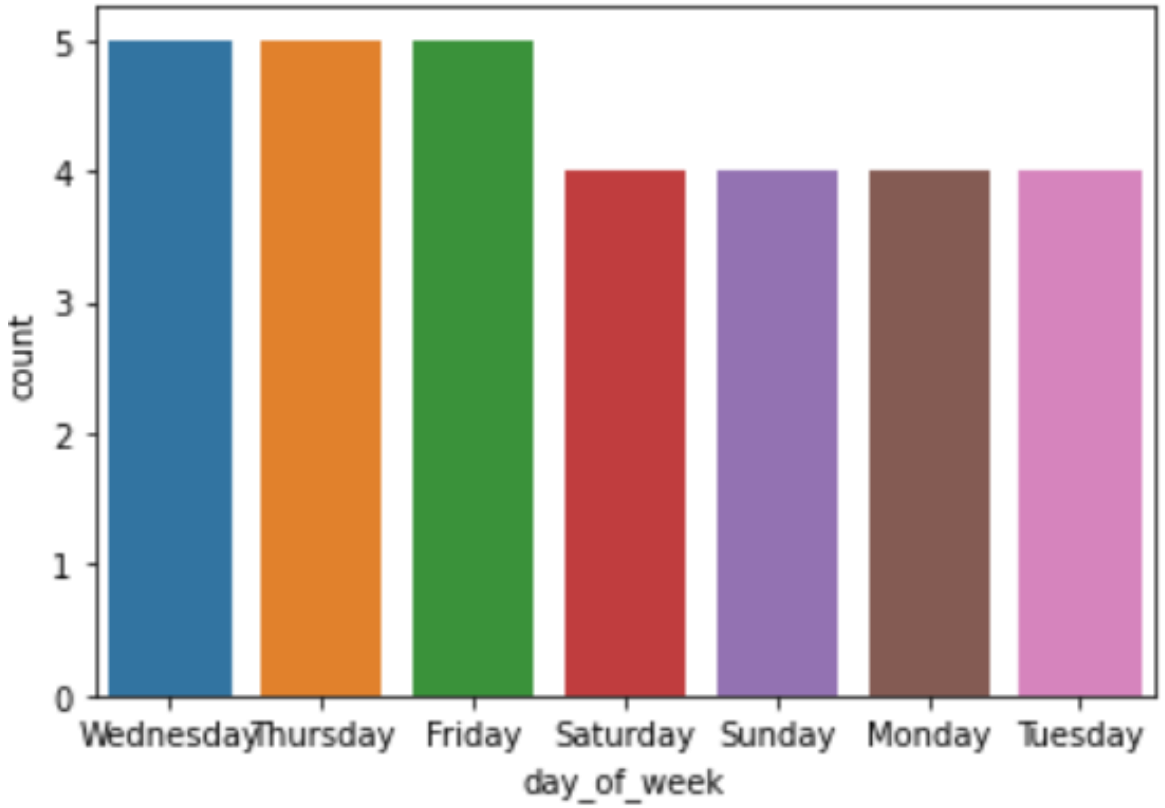
```
sns.heatmap(df.corr(), annot=True)
```



씨본(Seaborn)

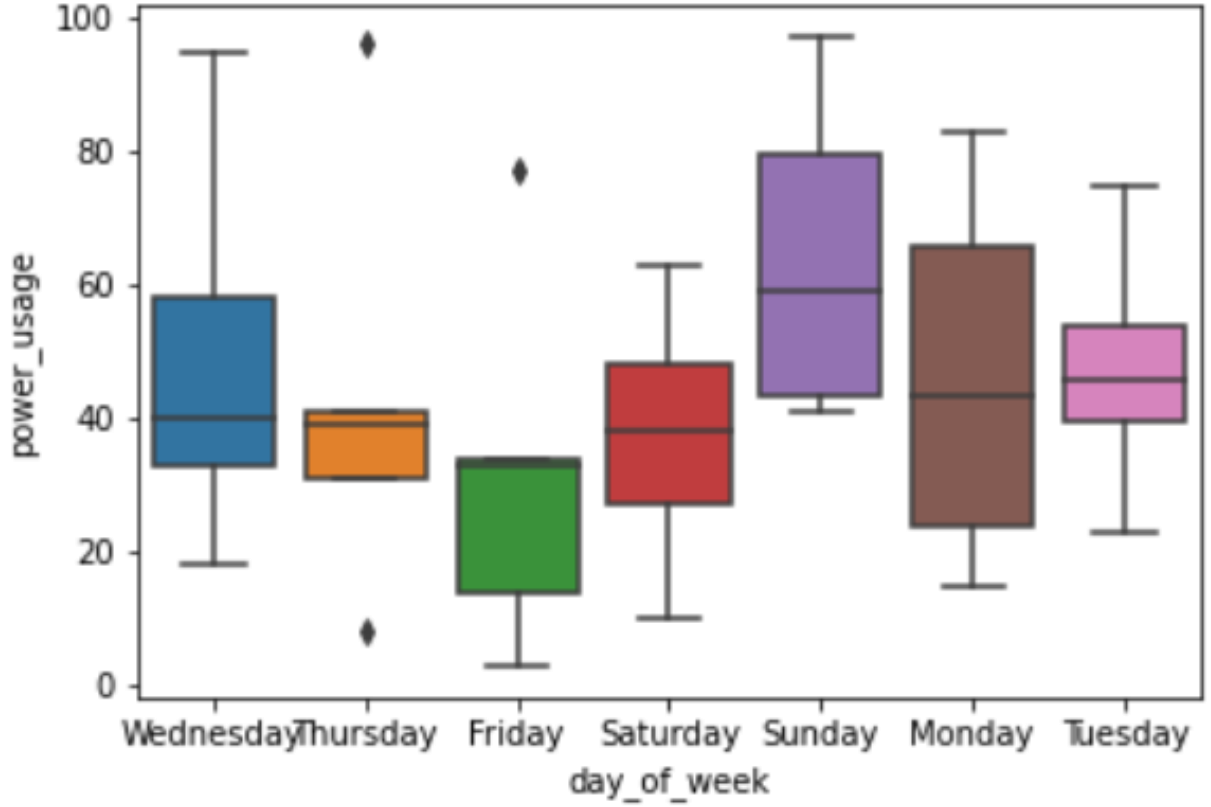
■ 카운트 플롯

```
sns.countplot(x='day_of_week',
              data=df)
```



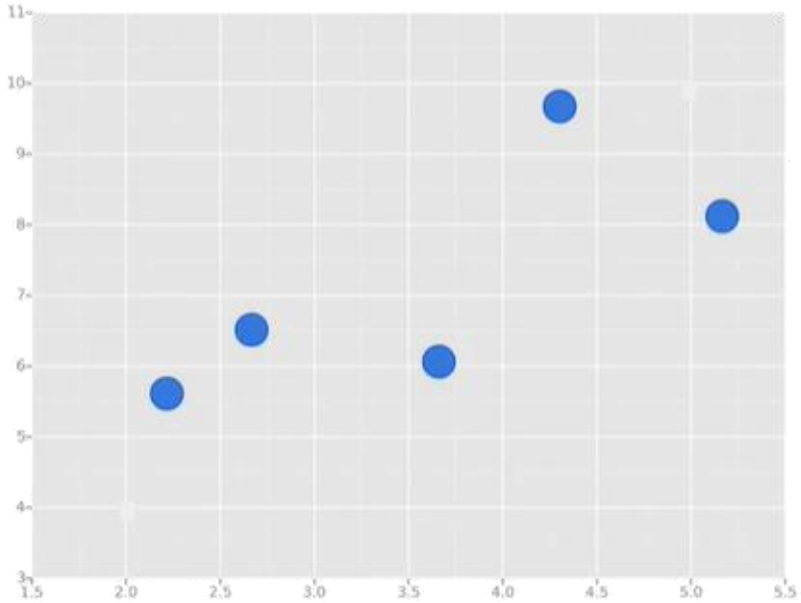
■ 박스 플롯

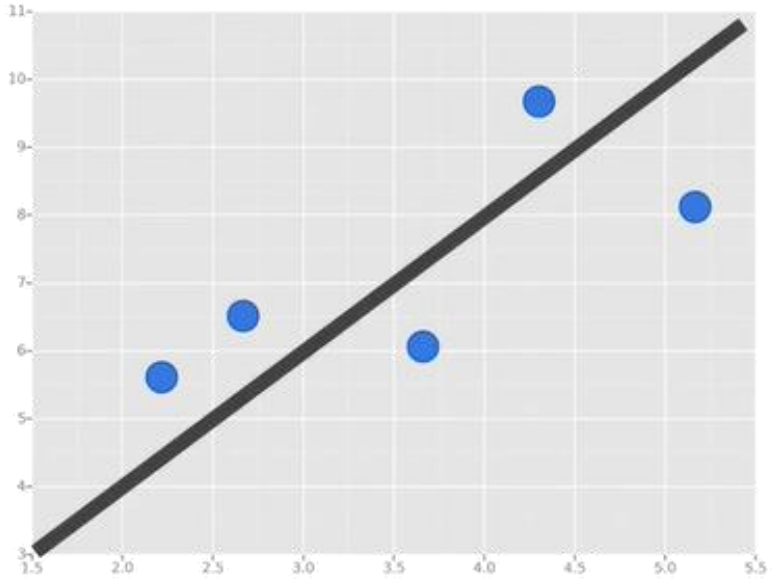
```
sns.boxplot(x='day_of_week',
            y='power_usage', data=df)
```

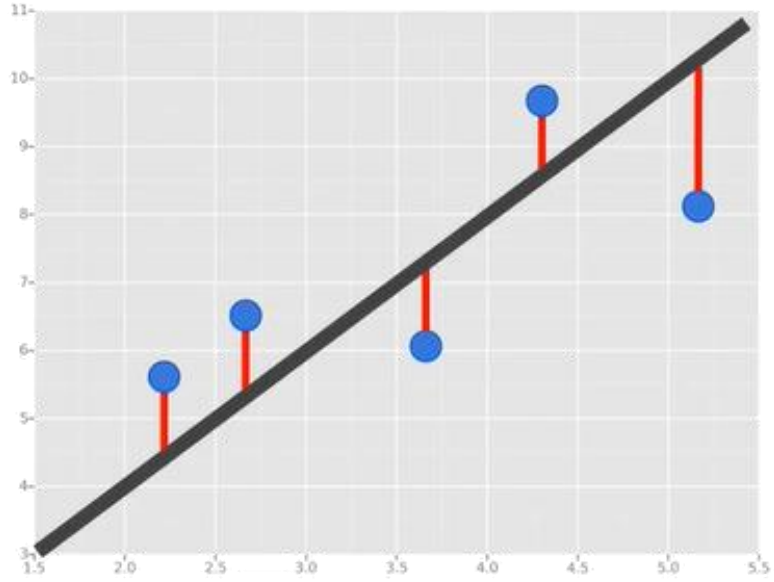


선형 회귀

종속 변수 y와 한 개 이상의 독립 변수 X와의 선형 상관 관계를 모델링 하는 회귀분석 기법







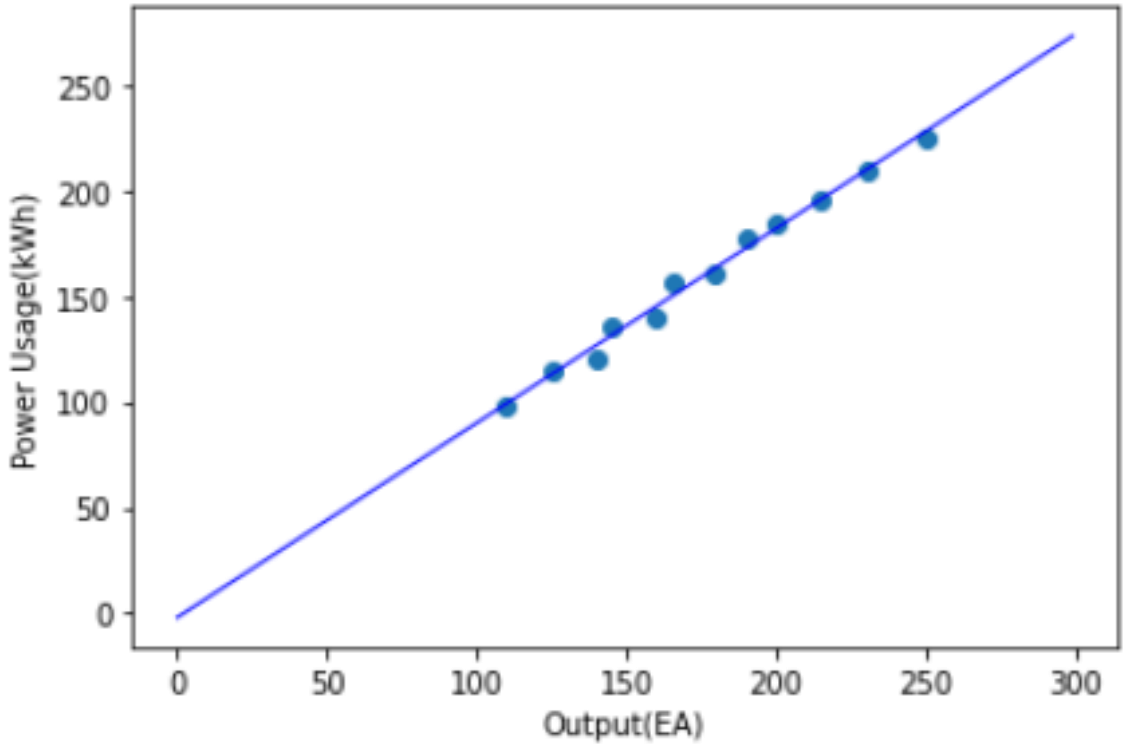
선형 회귀

```
import numpy as np
from scipy import stats
import matplotlib.pyplot as plt

# 생산량
output = [110, 125, 140, 145, 160, 166, 179, 190, 200, 215, 230, 250]

# 전력사용량
power_usage = [98, 115, 120, 136, 140, 156, 160, 177, 185, 195, 210, 225]

# p-value   : 유의 확률, 일반적으로 0.05 미만일 때 유의미
slope, intercept, r_value, p_value, stderr = stats.linregress(output, power_usage)
```

선형 회귀

```
# 생산량 134개일 때 전기사용량 예측
product = 134
print("기울기(slope) : ", slope)
print("절편(intercept) : ", intercept)
print("상관계수(r_value) : ", r_value)
print("유의확률(p_value) : ", p_value )
print("{}개 => 예측량 {}kWh".format(
      product, product*slope + intercept))


plt.scatter(output, power_usage)
x = np.arange(0, 300)
y = [(slope*num + intercept) for num in x]
plt.plot(x, y, 'b', lw=1)
plt.xlabel("Output(EA)")
plt.ylabel("Power Usage(kWh)")
plt.show()
```

```
기울기(slope) :  0.9200457304535211
절편(intercept) :  -2.024707604744151
상관계수(r_value) :  0.9950415352828844
유의확률(p_value) :  2.3409613797567155e-11
134개 => 예측량 121.26142027602768kWh
```



에너지 데이터 분석 실습

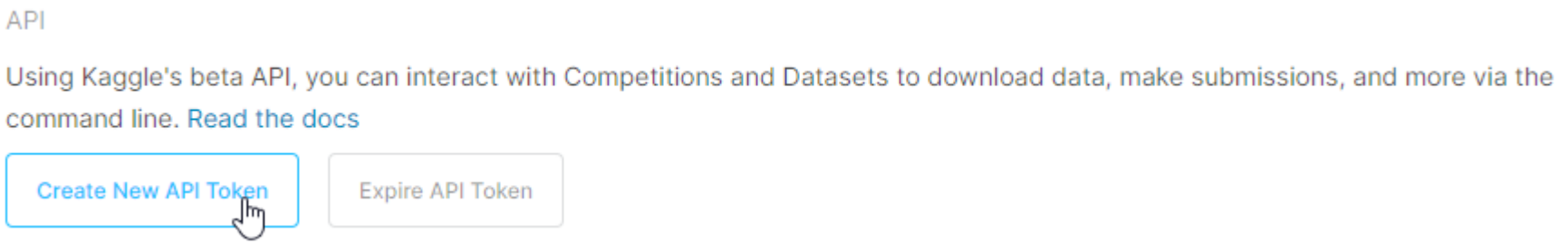
energy_data_analysis.ipynb

charts.ipynb

에너지 사용량 분석 실습

■ kagge 가입 및 kgggle.json 다운로드

- kaggle 가입 : https://www.kaggle.com/
- kgggle.json 다운로드 : https://www.kaggle.com/<username>/account



■ 데이터셋

- https://www.kaggle.com/code/sudalairajkumar/simple-exploration-notebook-ashrae/data
- train.csv
- test.csv
- building_metadata.csv
- weather_train.csv

에너지 사용량 분석 실습

■ kaggle 패키지 설치

```
!pip install  kaggle
```

■ kaggle API 키 업로드

```
from google.colab import files

files.upload()
```

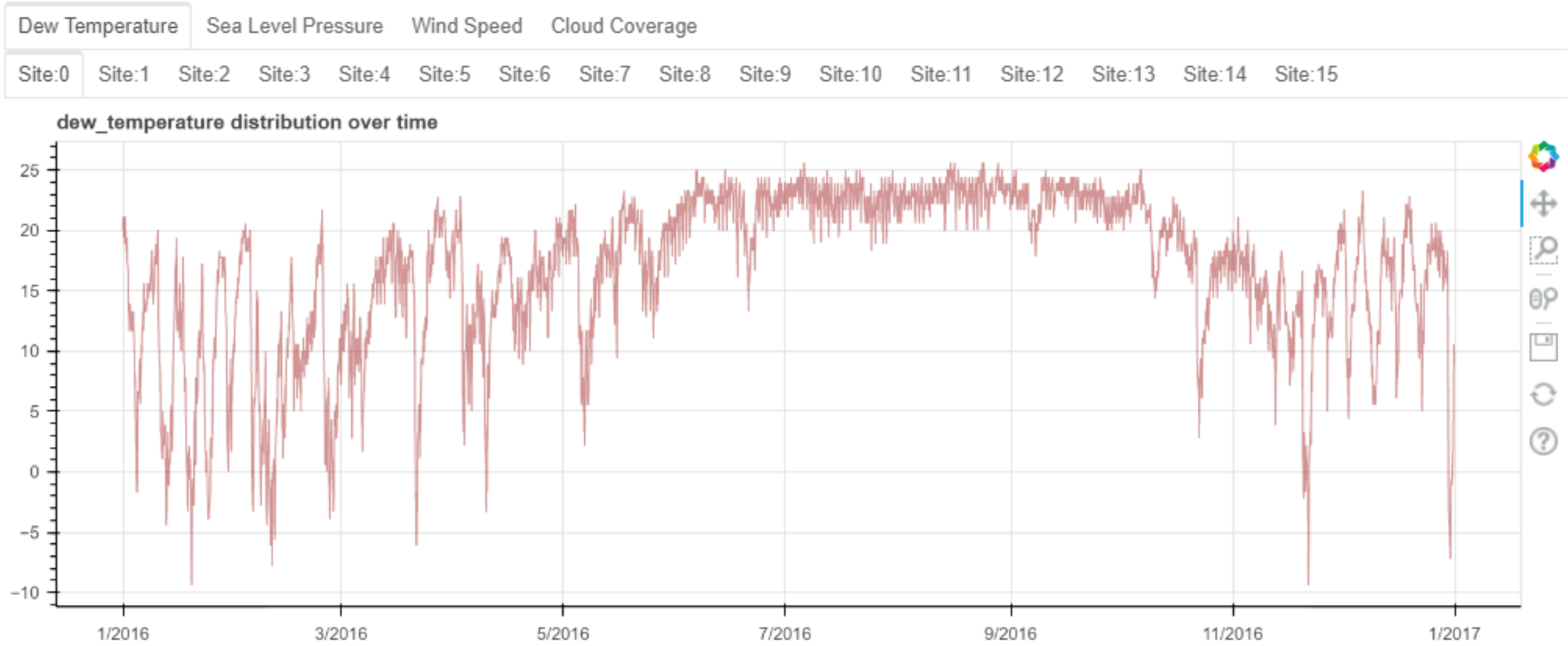
```
!mkdir ~/.kaggle
!cp kaggle.json ~/.kaggle/
!chmod 600 ~/.kaggle/kaggle.json
```

■ kaggle 패키지 설치

```
!kaggle competitions download -c ashrae-energy-prediction
```

에너지 사용량 분석 실습

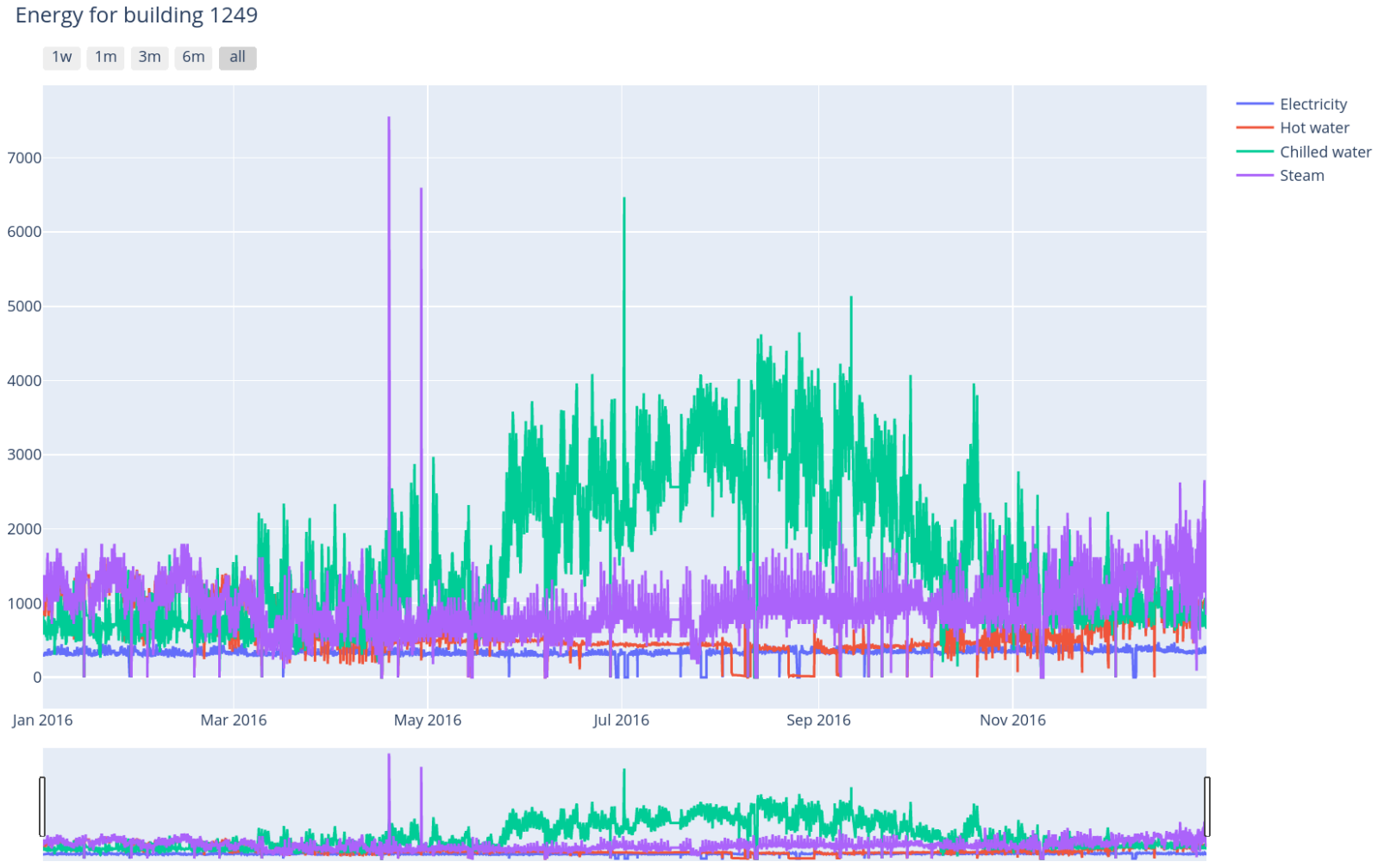
energy_data_exploration.ipynb



에너지 데이터 인터랙티브 분석 실습

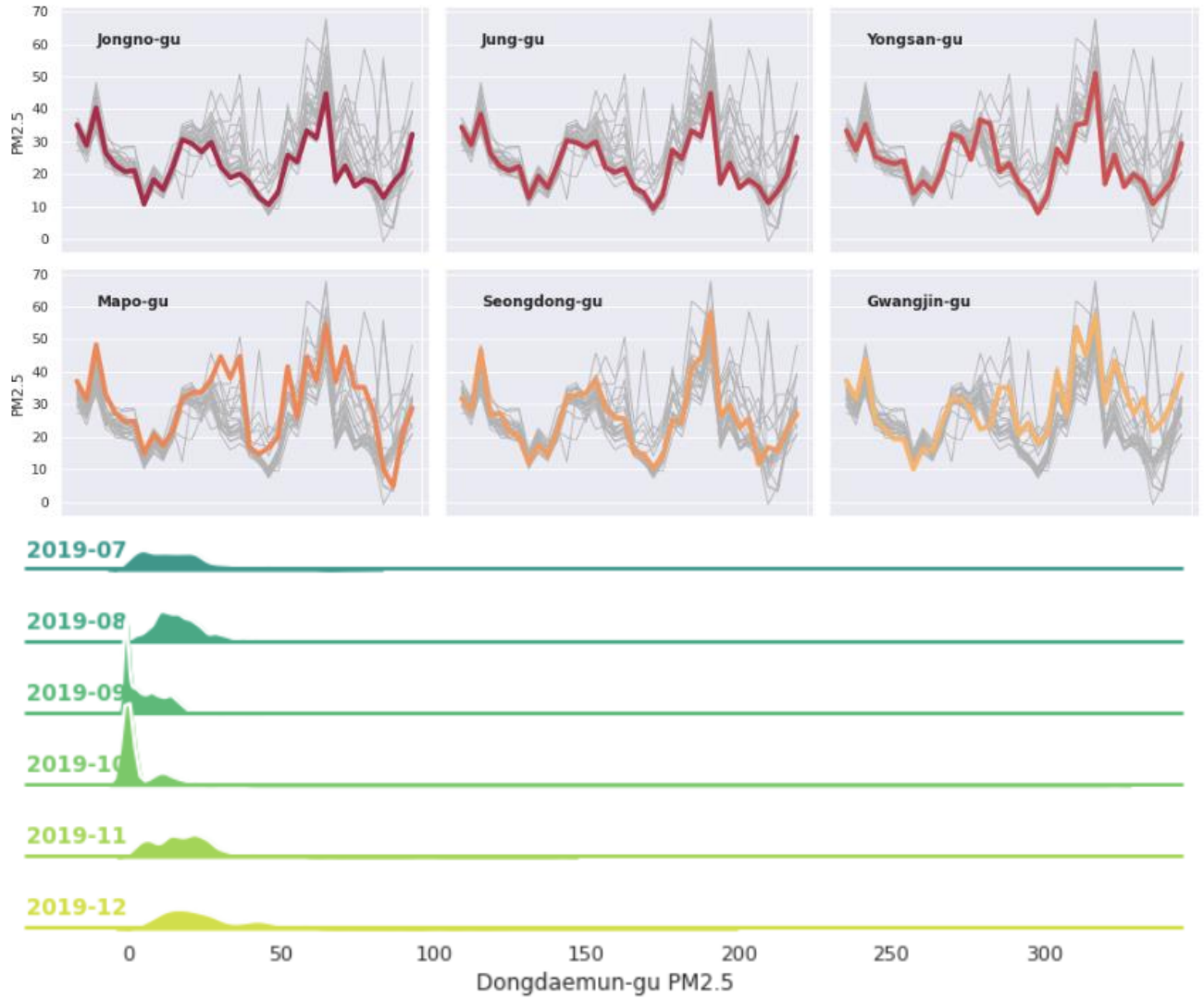
energy_data_interactive_browser.ipynb

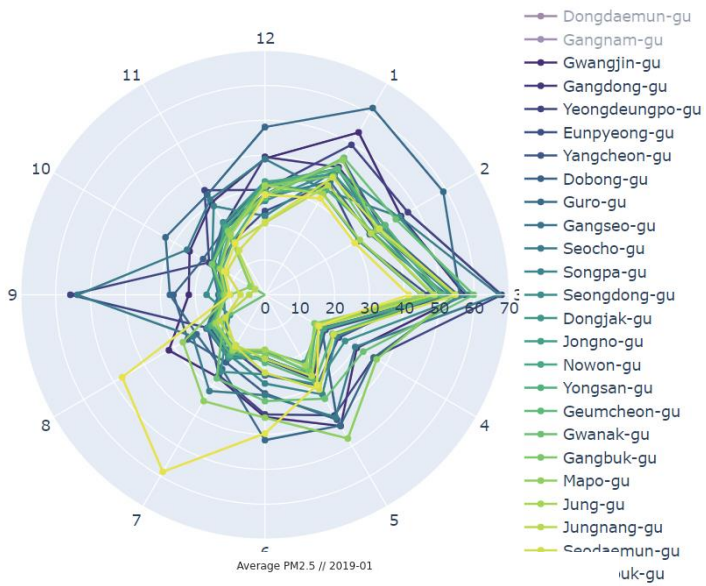
Building: 1249 Refresh

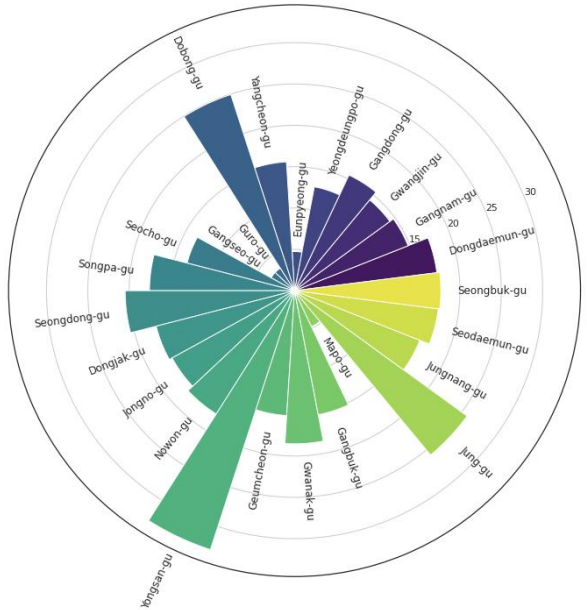


다중 시계열 데이터 분석 시각화 실습

multiple_time_series_data_analysis.ipynb







자바스크립트 차트 라이브러리 - Plotly

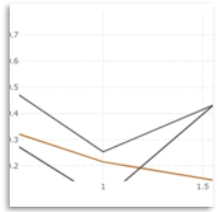
https://plot.ly/javascript/

Fundamentals

More Fundamentals »


Configuration Options


Responsive / Fluid Layouts

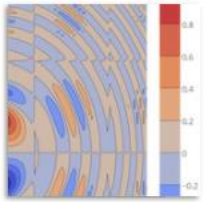

uirevision in Plotly.react

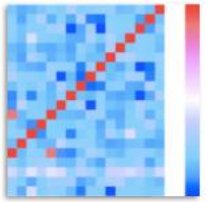

React Plotly.js


Analytical Apps with Dash

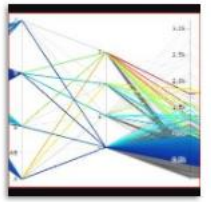
Scientific Charts

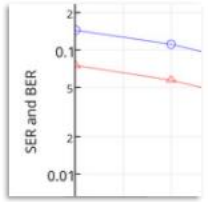
More Scientific Charts »


Contour Plots


Heatmaps


Ternary Plots

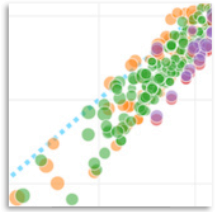

Parallel Coordinates Plot

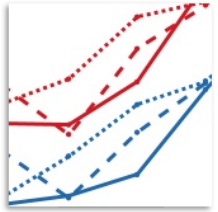


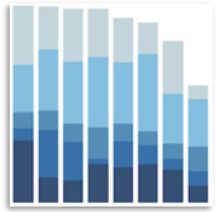
Log Plots

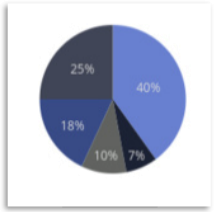
Basic Charts

More Basic Charts »


Scatter Plots


Line Charts


Bar Charts



Pie Charts

Bubble Charts

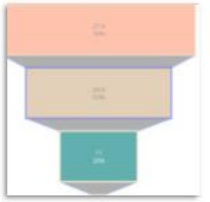
Financial Charts

More Financial Charts »


Waterfall Charts

Indicators

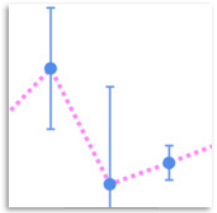

Candlestick Charts

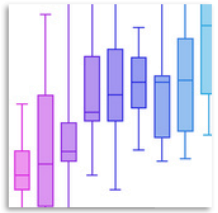

Funnel and Funnelarea Charts

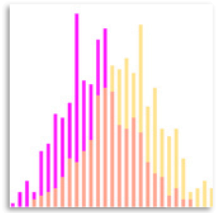
Time Series

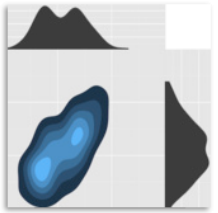
Statistical Charts

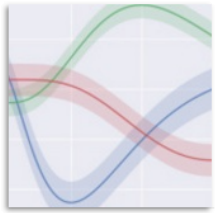
More Statistical Charts »


Error Bars


Box Plots


Histograms

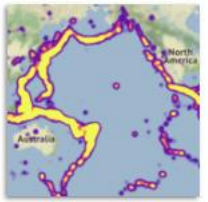

2d Density Plots


Continuous Error

Maps

More Maps »


Mapbox Map Layers


Mapbox Density


Choropleth Mapbox


Lines on Maps

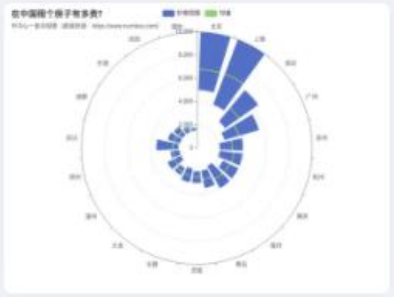

Bubble Maps

자바스크립트 차트 라이브러리 - ECharts

https://echarts.apache.org/examples/en/index.html

Finance Indices 2002

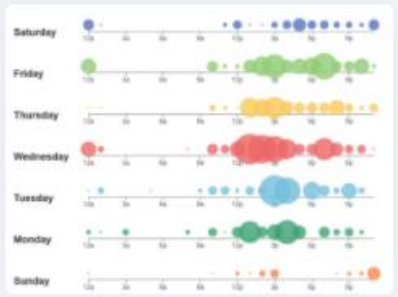
Watermark - ECharts Download

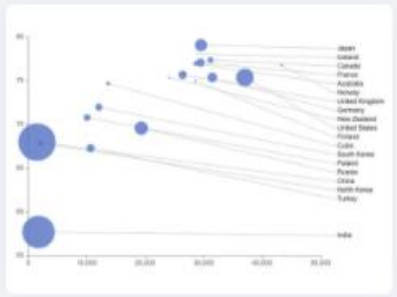


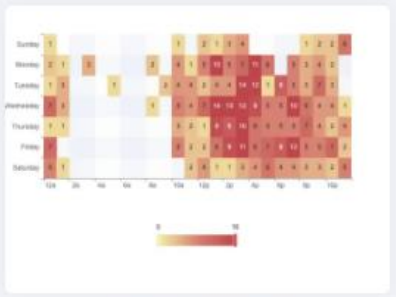
Bar Chart on Polar

Stacked Bar Chart on Polar

ShangHai Index

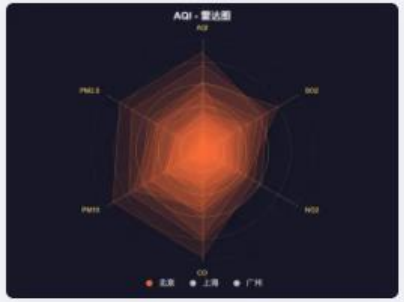




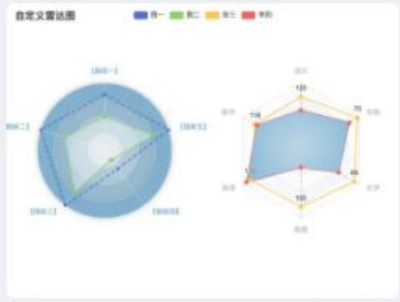


Heatmap on Cartesian

Basic Radar Chart

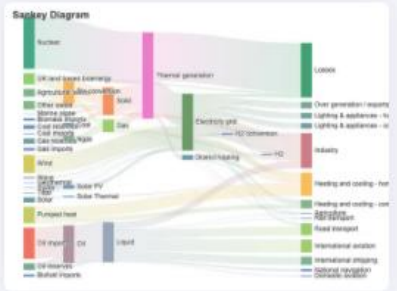


AQI - Radar Chart



Customized Radar Chart

Proportion of Browsers



Gradient Edge

Thank you

kgpark88@gmail.com