보스턴 집값 예측하기

- 데이터셋 저장소 : https://archive.ics.uci.edu/dataset/186/wine+quality (캘리포니아 어바인 대학 머신러닝 저장소)

```
- CRIM: 지역별 범죄 발생률
- ZN: 25,000평방피트를 초과하는 거주 지역의 비율
- INDUS: 비상업 지역 넓이 비율
- CHAS: 찰스강에 대한 더미 변수(강의 경계에 위치한 경우는 1, 아니면 0)
- NOX: 일산화질소 농도
- RM: 거주할 수 있는 방 개수
- AGE: 1940년 이전에 건축된 소유 주택의 비율
- DIS: 5개 주요 고용센터까지의 가중 거리
- RAD: 고속도로 접근 용이도
- TAX: 10,000달러당 재산세율
- PTRATIO: 지역의 교사와 학생 수 비율
- B: 지역의 흑인 거주 비율
- LSTAT: 하위 계층의 비율
- PRICE: 본인 소유의 주택 가격(중앙값) - 종속변수 (위의 건 독립변수)
```

In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

sns.set(style='whitegrid')

#한글 표기 설정
from matplotlib import rc, font_manager
fontname='c:/Windows/Fonts/malgun.ttf'
font_name=font_manager.FontProperties(fname=fontname).get_name()
rc('font',family=font_name)

#축에 마이너스 표기
plt.rcParams['axes.unicode_minus']=False

#그래프 사이즈 설정
plt.rcParams['figure.figsize']=(5,4)
```

In [ ]:
```
data_url = "http://lib.stat.cmu.edu/datasets/boston"
raw_df = pd.read_csv(data_url, sep="₩s+", skiprows=22, header=None)
data = np.hstack([raw_df.values[::2, :], raw_df.values[1::2, :2]])
target = raw_df.values[1::2, 2]
```

In [ ]:
```
df= pd.DataFrame(data, columns=['CRIM','ZN','INDUS','CHAS','NOX','RM','AGE','DIS','F
```

요약통계

```
1. chas 에 따른 집가격(target)의 평균, 표준편차, 중앙값을 구하라.
2. 선형회귀분석 모델을 생성하고, 모델을 사용하여 예측값을 구하라.
3. 새로운 데이터 2개를 사용하여 예측값을 구하라.
4. 부분회귀분석 시각화를 작성하여 독립변수들이 종속변수에 미치는 영향을
분석하라.
```

- 1개 독립변수 분석(plot_partregress)은 (CRIM)으로 한다.
- plot_partregress_grid() 작성

In [ ]:
```
df['TARGET']=target
df
```

Out[ ]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTA
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1.0	296.0	15.3	396.90	4.9
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2.0	242.0	17.8	396.90	9.1
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2.0	242.0	17.8	392.83	4.0
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3.0	222.0	18.7	394.63	2.9
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3.0	222.0	18.7	396.90	5.3
...	...	...	...	...	...	...	...	...	...	...	...	...	
501	0.06263	0.0	11.93	0.0	0.573	6.593	69.1	2.4786	1.0	273.0	21.0	391.99	9.6
502	0.04527	0.0	11.93	0.0	0.573	6.120	76.7	2.2875	1.0	273.0	21.0	396.90	9.0
503	0.06076	0.0	11.93	0.0	0.573	6.976	91.0	2.1675	1.0	273.0	21.0	396.90	5.6
504	0.10959	0.0	11.93	0.0	0.573	6.794	89.3	2.3889	1.0	273.0	21.0	393.45	6.4
505	0.04741	0.0	11.93	0.0	0.573	6.030	80.8	2.5050	1.0	273.0	21.0	396.90	7.8

506 rows × 14 columns

1. chas 에 따른 집가격(target)의 평균, 표준편차, 중앙값을 구하라.

In [ ]:
```
df.groupby(['CHAS']).agg({'TARGET':['mean','std','median']})
```

Out[ ]:

	TARGET		
	mean	**std**	**median**
CHAS			
0.0	22.093843	8.831362	20.9
1.0	28.440000	11.816643	23.3

1. 선형회귀분석 모델을 생성하고, 모델을 사용하여 예측값을 구하라.

In [ ]:
```
from statsmodels.formula.api import ols, glm
Rformula = 'TARGET ~ CRIM + ZN + INDUS + ₩
      CHAS + NOX + RM + AGE + ₩
      DIS + RAD + TAX + PTRATIO+B+LSTAT'

regression_result=ols(Rformula, data=df).fit()
```

In [ ]:
```
regression_result.summary()
```

Out[ ]:

OLS Regression Results

Dep. Variable:	TARGET	**R-squared:**	0.741
Model:	OLS	**Adj. R-squared:**	0.734
Method:	Least Squares	**F-statistic:**	108.1
Date:	Wed, 12 Jul 2023	**Prob (F-statistic):**	6.72e-135
Time:	13:38:16	**Log-Likelihood:**	-1498.8
No. Observations:	506	**AIC:**	3026.
Df Residuals:	492	**BIC:**	3085.
Df Model:	13		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	36.4595	5.103	7.144	0.000	26.432	46.487
CRIM	-0.1080	0.033	-3.287	0.001	-0.173	-0.043
ZN	0.0464	0.014	3.382	0.001	0.019	0.073
INDUS	0.0206	0.061	0.334	0.738	-0.100	0.141
CHAS	2.6867	0.862	3.118	0.002	0.994	4.380
NOX	-17.7666	3.820	-4.651	0.000	-25.272	-10.262
RM	3.8099	0.418	9.116	0.000	2.989	4.631
AGE	0.0007	0.013	0.052	0.958	-0.025	0.027
DIS	-1.4756	0.199	-7.398	0.000	-1.867	-1.084
RAD	0.3060	0.066	4.613	0.000	0.176	0.436
TAX	-0.0123	0.004	-3.280	0.001	-0.020	-0.005
PTRATIO	-0.9527	0.131	-7.283	0.000	-1.210	-0.696
B	0.0093	0.003	3.467	0.001	0.004	0.015
LSTAT	-0.5248	0.051	-10.347	0.000	-0.624	-0.425

Omnibus:	178.041	**Durbin-Watson:**	1.078
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	783.126
Skew:	1.521	**Prob(JB):**	8.84e-171
Kurtosis:	8.281	**Cond. No.**	1.51e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.51e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

In [ ]:
```
sample1=df[df.columns.difference(['TARGET'])]
sample1[:5]
sample1_predict=regression_result.predict(sample1)
```

In [ ]:
```
print(sample1_predict[100:105])
print(df['TARGET'][100:105])
```

```
100    24.580220
101    25.594135
102    19.790137
103    20.311671
104    21.434826
dtype: float64
100    27.5
101    26.5
102    18.6
103    19.3
104    20.1
Name: TARGET, dtype: float64
```

1. 새로운 데이터 2개를 사용하여 예측값을 구하라.

In [ ]:
```
data = {
    "CRIM" : [0.02729, 0.03237],
    "ZN":[0.0    , 0.0],
    "INDUS":[7.07, 2.18],
    "CHAS":[0.0, 0.0],
    "NOX":[0.469, 0.458],
    "RM":[7.185, 6.998],
    "AGE":[61.1, 45.8],
    "DIS":[4.9671, 6.0622],
    "RAD":[2.0, 3.0],
    "TAX":[242.0, 222.0],
    "PTRATIO":[17.8, 18.7],
    "B":[392.83, 394.63],
    "LSTAT":[4.03, 2.94]}
# "TARGET":[34.7,  33.4]

sample2=pd.DataFrame(data, columns=sample1.columns)
```

In [ ]:
```
sample2_predict=regression_result.predict(sample2)
print(sample2_predict)
```

```
0    30.567597
1    28.607036
dtype: float64
```

1. 부분회귀분석 시각화를 작성하여 돌립변수들이 종속변수에 미치는 영향을 분석하라.
    - 1개 독립변수 분석(plot_partregress)은 (CRIM)으로 한다.
    - plot_partregress_grid() 작성

In [ ]:
```
import statsmodels.api as sm
sns.set_style('dark')
```

In [ ]:
```
others=list(set(df.columns).difference(set(['TARGET','CRIM'])))
```

In [ ]:
```
sm.graphics.plot_partregress('TARGET', 'CRIM', others, data=df, ret_coords=True, ob
```

```
eval_env: 1
```

Out[ ]:
```
(<Figure size 500x400 with 1 Axes>,
 (array([ 2.02894528e+00,  1.72554915e+00,  3.17028464e+00,  3.27703139e+00,
          2.81091614e+00,  2.52722763e+00, -4.59346397e-01, -1.68368101e+00,
         -4.34881188e+00, -8.60602683e-01, -1.59977351e+00, -1.66230760e-01,
         -1.35751341e+00,  2.04577860e+00,  1.26534129e+00,  1.80216091e+00,
          2.66024754e+00,  2.60632332e-01, -4.02035431e-01,  6.42586087e-01,
         -1.35452622e+00,  3.89318138e-01, -3.09798152e-01, -8.87252802e-01,
         -2.29589952e-02, -9.13037285e-01,  2.50496297e-01, -8.05873765e-01,
          9.93024920e-01,  1.25827326e+00, -1.64348287e+00,  1.06320797e+00,
         -3.89121688e+00, -9.55801645e-01, -1.91329083e+00, -9.72014476e-01,
         -1.54117502e+00, -3.26688518e-01, -5.93143499e-01, -4.92106111e-01,
          2.16841068e-01,  2.78257634e+00,  2.34231025e+00,  2.09668642e+00,
          1.42163928e+00,  8.25775922e-01, -5.02194852e-02, -7.15800694e-01,
         -3.57771154e+00,  9.79165682e-02, -2.71947533e-01,  6.42369972e-01,
          1.84746725e+00,  9.29256339e-01, -1.39874635e+00, -4.99553876e-02,
          1.66208660e+00, -8.03160339e-01,  1.49625213e-01, -1.12097558e+00,
         -1.89796443e+00, -2.59262587e+00, -1.69723637e-01, -1.48144803e-01,
          3.30510306e+00, -7.60659723e-01, -2.25149040e+00,  1.18862723e+00,
         -1.87108588e-02,  1.08969284e+00,  1.54912492e+00,  6.42542798e-01,
          1.78471183e+00,  1.34303479e+00,  7.03390062e-01,  2.28388848e-01,
         -9.32283819e-01, -3.99377914e-01, -2.48173761e-01,  1.75892682e-01,
          8.30987293e-01,  2.81796245e-01,  3.48939149e-01,  3.69663353e-02,
          7.41945841e-01,  1.26026216e+00, -3.99978104e-01,  1.91110018e-01,
          1.62564774e+00,  1.61703336e+00,  3.86698667e-01,  5.21432361e-01,
         -4.35493426e-01, -2.07771307e-02, -1.12157986e+00,  6.92962543e-01,
         -2.64901968e-01,  2.09918017e+00,  2.14783368e+00,  1.37988893e+00,
         -3.99467824e-01,  7.15688540e-02, -3.87300968e+00, -1.53891021e+00,
         -1.56810046e+00, -2.87505183e+00, -3.26175695e+00, -2.25787058e+00,
         -1.43938926e+00, -2.10971934e+00, -1.43984721e+00, -1.13566202e+00,
         -3.05842477e+00, -2.95371776e+00, -1.68455028e+00, -3.29539740e+00,
         -1.70084509e+00, -1.31301002e+00, -3.29278113e+00, -2.19344406e+00,
          4.68870264e-01,  3.67713818e-01, -5.73912037e-01, -2.49545218e+00,
         -5.62046705e-01,  2.51587983e-01, -3.01234893e+00, -9.32654556e-01,
         -1.35783934e-01, -4.16749649e-01,  7.44275514e-01,  1.76065238e+00,
          1.37461381e+00,  1.41386569e-01, -1.07152684e+00, -1.14718720e-01,
         -7.20487536e-01,  8.72498334e-02, -1.94878086e+00, -8.34590050e-01,
         -2.54278984e+00, -4.05330800e+00,  1.20835084e+00,  8.52997839e-01,
         -1.37387460e+00, -3.11275864e+00, -8.43525330e-01, -1.79937293e+00,
         -1.74666459e+00,  3.59205501e-01,  1.45280297e+00,  9.23642324e-01,
          2.05309418e+00,  3.47281839e-01,  1.88174857e+00,  1.81352890e+00,
         -1.16081422e+00,  1.78630513e+00,  9.98266323e-01,  2.95203268e+00,
          2.41672901e+00,  3.06358604e+00,  4.99088959e+00,  4.61871588e+00,
          1.47689146e+00,  1.08573908e+00,  3.29020591e+00, -6.62888983e-01,
          6.43244005e-01,  1.20090653e+00, -1.19607170e+00,  9.83441407e-01,
         -3.01764134e+00, -1.42300121e+00, -1.71986170e+00, -1.60928548e-01,
         -1.15736972e+00, -3.55168372e-01, -6.37014871e-01,  6.27264924e-01,
          1.95662207e-01, -8.49656457e-01,  6.07834680e-01,  3.41933899e-01,
         -1.90088989e+00, -1.34637703e+00,  1.27734210e+00, -2.07027543e+00,
         -1.13744398e+00, -1.04277617e+00,  1.49397569e-01,  2.56411127e-01,
          8.63309255e-01,  1.20594942e+00,  1.11410664e+00, -8.67619273e-01,
          8.77284016e-01, -6.55916353e-01,  2.21234500e-01,  2.90992687e-01,
          2.37735421e-01, -8.45322567e-01,  6.90678195e-01, -1.89300320e+00,
         -1.64792204e+00,  2.05658444e-02,  4.66183403e-01, -1.44332880e+00,
          5.05892448e-01, -1.58538752e+00, -2.91901352e-01, -1.98444716e+00,
         -1.38091752e-01,  4.17967462e-01, -5.08568694e+00,  4.51119855e-01,
         -1.28953044e-01, -8.37142864e-02, -1.25131462e+00,  9.49576751e-01,
         -1.12008455e+00, -3.94044518e+00, -6.37681911e-01, -1.43824175e+00,
         -7.69456259e-01, -5.55227939e-01, -3.01184970e-01, -1.46362939e+00,
         -5.78187089e-01, -7.55303204e-01, -2.58213402e+00, -7.02005489e-01,
          6.12781233e-01, -2.05026307e-01, -4.26949004e-01, -2.57168617e+00,
         -1.27839303e-01, -4.93035970e-02, -4.65886515e-01, -6.41846599e-01,
         -1.30949457e+00, -1.80768794e+00, -1.14244592e+00,  3.94225153e-01,
         -8.92574798e-01, -2.13959666e+00,  4.97560875e-01, -3.36871084e-02,
          1.62400241e-02,  1.06053080e+00,  8.14002088e-01,  1.23689169e+00,
```

```
 2.45277105e+00,  3.27462584e+00,  2.12406897e+00,  1.44146540e+00,
-3.11655078e-01, -1.68124797e-04, -1.04910387e+00, -8.45413707e-01,
-1.37029404e+00, -7.54187551e-01, -6.79943134e-02, -1.46950561e+00,
-1.19752472e+00, -1.96886791e+00, -2.48609667e+00, -7.98018954e-01,
 2.89721318e-01, -1.72352525e-01, -7.80911212e-01,  8.34866402e-01,
 1.80323447e-01,  2.54364562e+00,  1.19959612e+00,  2.10462947e-01,
 1.23247485e+00,  1.60940555e+00, -9.98055167e-01, -5.63530150e-01,
 1.41902483e-01,  1.36129527e-01,  1.88549660e+00,  1.62160209e+00,
 3.00285084e-01,  1.15344081e+00, -7.60230400e-02, -7.95543744e-01,
-8.80462729e-01, -1.46090409e+00, -9.94309518e-01, -9.08312633e-01,
-1.38730225e+00,  1.36508111e+00,  8.63955659e-01,  2.44797840e+00,
 1.99968792e+00,  1.26118895e-01, -5.19335064e-01, -1.95559584e-01,
-4.42534899e-01, -2.15568533e+00, -2.02156748e+00, -8.87008994e-01,
-2.29492422e+00, -3.46226171e+00, -2.76971278e+00, -3.17502477e+00,
 1.94495198e+00,  1.48907876e-01,  6.70840814e-01,  1.29110126e+00,
-5.42269005e-01,  7.33197441e-01,  8.65316199e-01,  2.00808876e-01,
-1.29821045e+00, -7.53870451e-01,  5.54608258e-01,  3.33370672e-01,
 8.40048294e-01,  9.12374500e-01,  9.08199494e-01, -3.10627547e-01,
 1.40883456e+00,  2.00580503e+00,  1.83726867e+00,  1.13631382e-01,
 2.65444407e-01,  9.84101050e-01,  8.69984025e-01,  9.48637316e-01,
 1.82781943e+00,  2.31941234e+00,  2.04830600e+00,  1.40417130e+00,
 3.70265233e-01,  4.30268342e-01,  4.44462934e-01,  1.48175703e-01,
 2.37471758e-01,  2.89042310e+00,  3.36358426e+00, -7.36497748e-01,
 4.05927133e-01,  2.67856726e+00,  1.95905122e+00,  4.63293766e-01,
 3.37717320e-01,  4.05611819e+00,  3.97206338e+00,  2.80267137e+00,
 2.25110606e+00,  2.13121306e+00,  1.40721972e+00,  2.08494435e+00,
-5.25930904e-01, -4.16688629e+00, -2.27909901e+00, -5.01027233e+00,
-3.64178607e+00, -6.29565620e+00, -5.66302503e+00, -5.10576339e+00,
-2.99156911e+00, -5.61208534e+00, -7.89998386e+00, -8.42279033e-01,
-4.50671124e+00, -1.94090429e+00, -7.29084465e-01, -1.43869798e+00,
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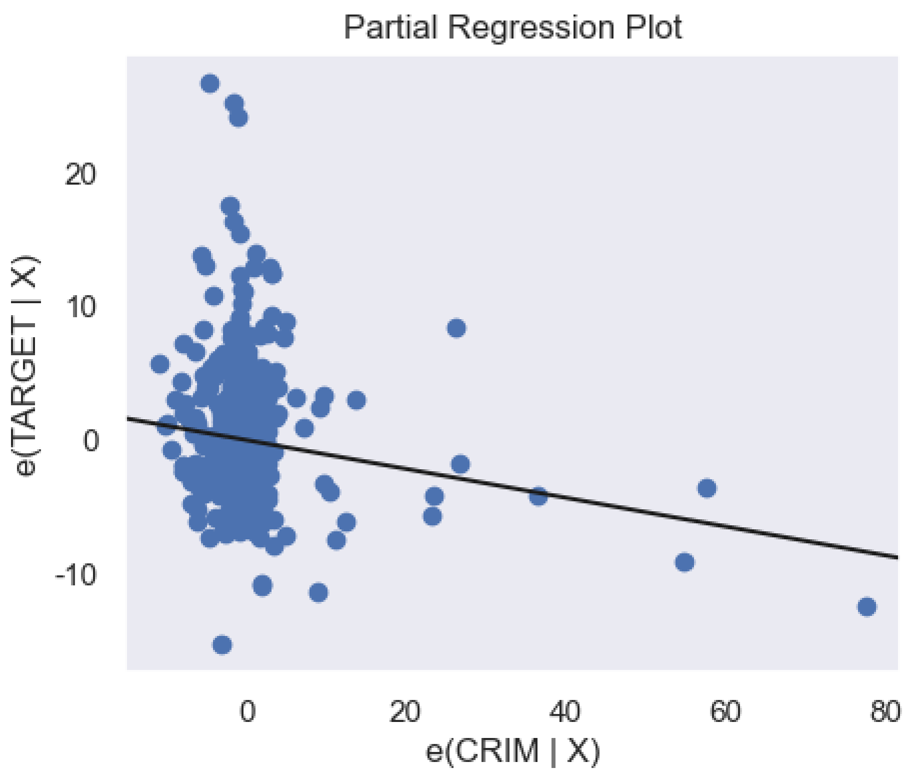

In [ ]:
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fig=plt.figure(figsize=(8,13))
sm.graphics.plot_partregress_grid(regression_result, fig=fig)
plt.show()
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Partial Regression Plot