다중회귀분석(Multivariate Regression)

```
import warnings
warnings.filterwarnings('ignore')
```

실습용 데이터 설정

- pandas DataFrame
  - Insurance.csv

```
import pandas as pd

DF = pd.read_csv('https://raw.githubusercontent.com/rusita-ai/pyData/master/Insurance.csv')

DF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1338 non-null   int64  
 1   sex       1338 non-null   object 
 2   bmi       1338 non-null   float64
 3   children  1338 non-null   int64  
 4   smoker    1338 non-null   object 
 5   region    1338 non-null   object 
 6   expenses  1338 non-null   float64
dtypes: float64(2), int64(2), object(3)
memory usage: 73.3+ KB
```

```
DF.head(3)
```

	age	sex	bmi	children	smoker	region	expenses
0	19	female	27.90	0	yes	southwest	16884.9240
1	18	male	33.77	1	no	southeast	1725.5523
2	28	male	33.00	3	no	southeast	4449.4620

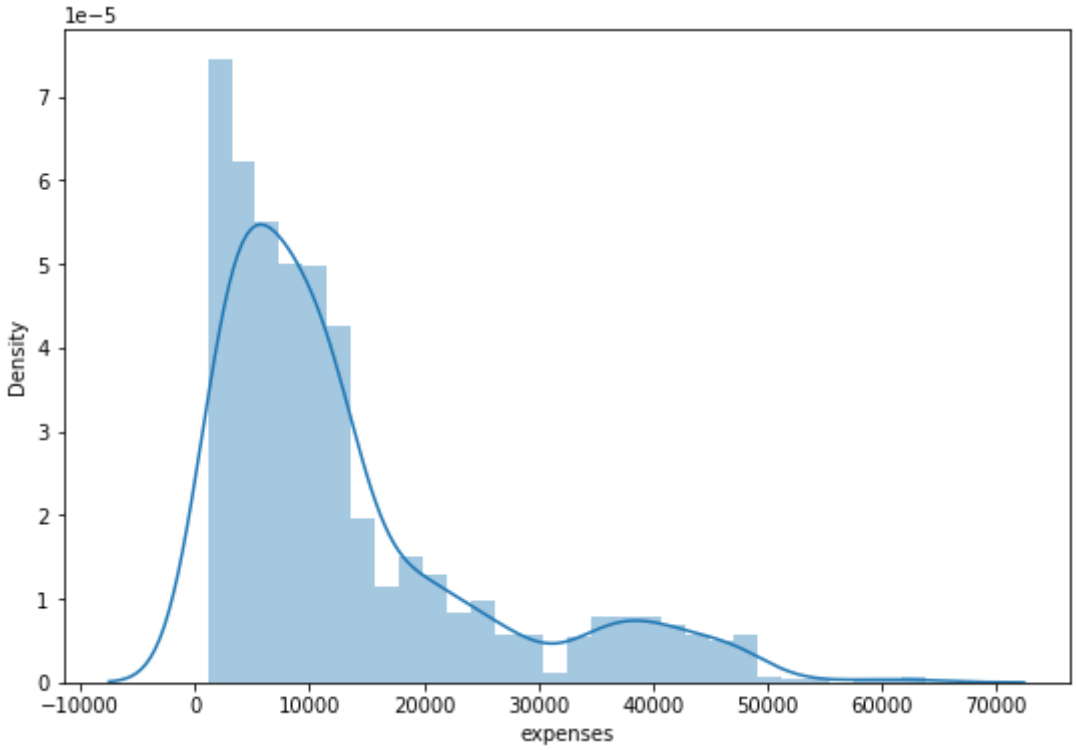
I. 탐색적 데이터 분석

- 시각화 패키지

```
import matplotlib.pyplot as plt
import seaborn as sns
```

1) 전체 의료비 분포

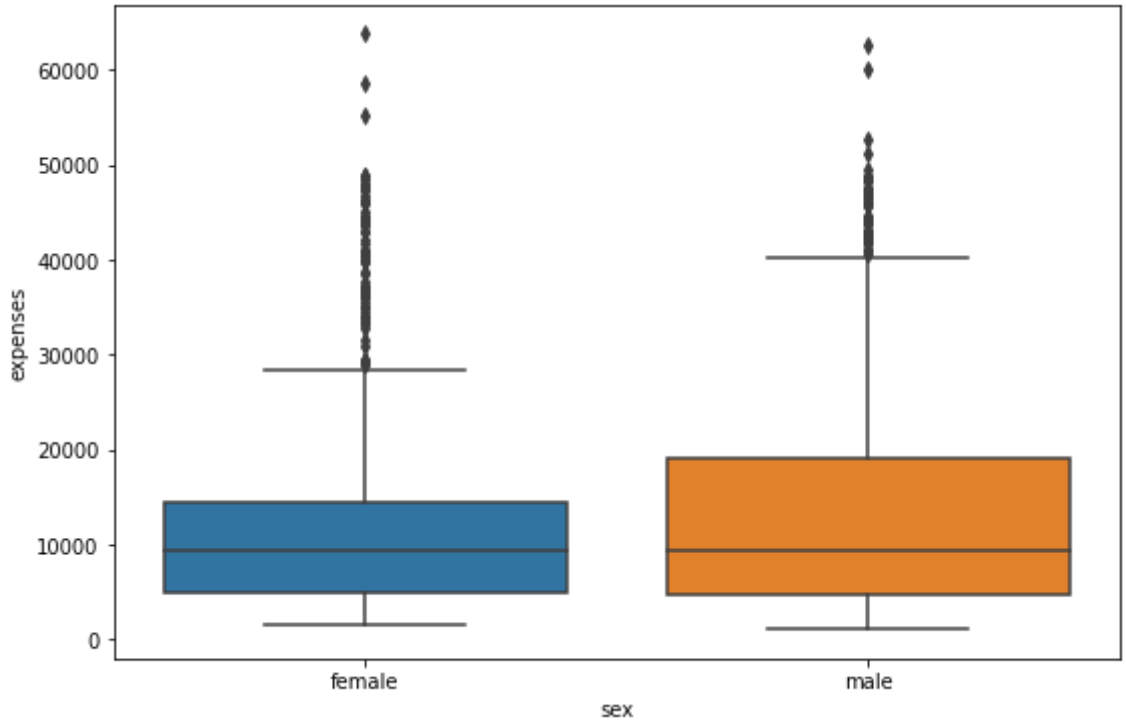
```
plt.figure(figsize = (9, 6))
sns.distplot(DF.expenses,
             hist = True,
             kde = True)
plt.show()
```




```
plt.figure(figsize = (9, 6))
sns.boxplot(y = 'expenses', data = DF)
plt.show()
```

2) 성별 별 의료비 분포

```
plt.figure(figsize = (9, 6))
sns.boxplot(x = 'sex', y = 'expenses', data = DF)
plt.show()
```

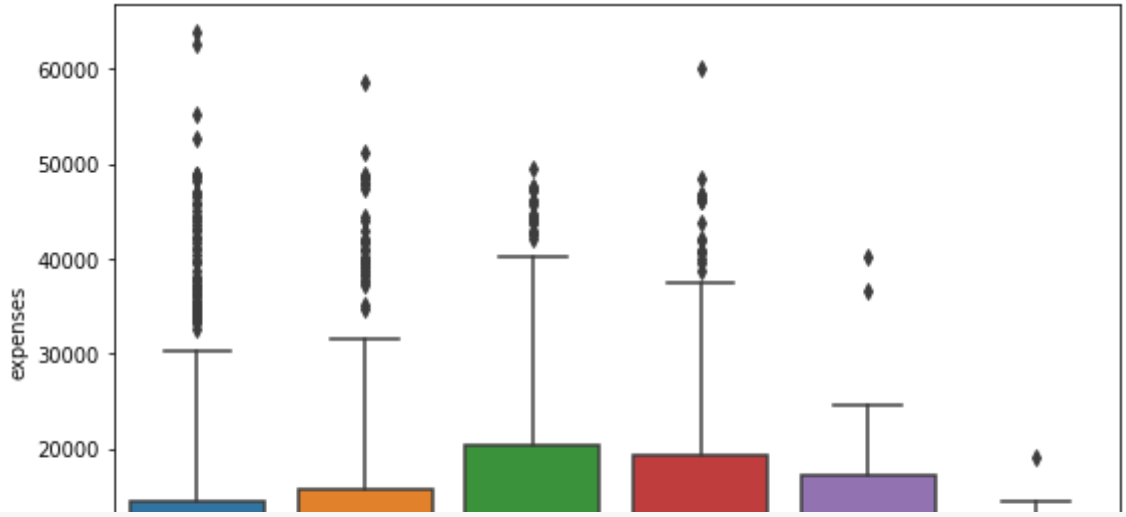



```
DF.sex.value_counts()
```

```
male      676
female    662
Name: sex, dtype: int64
```

3) 자녀수 별 의료비 분포

```
plt.figure(figsize = (9, 6))
sns.boxplot(x = 'children', y = 'expenses', data = DF)
plt.show()
```

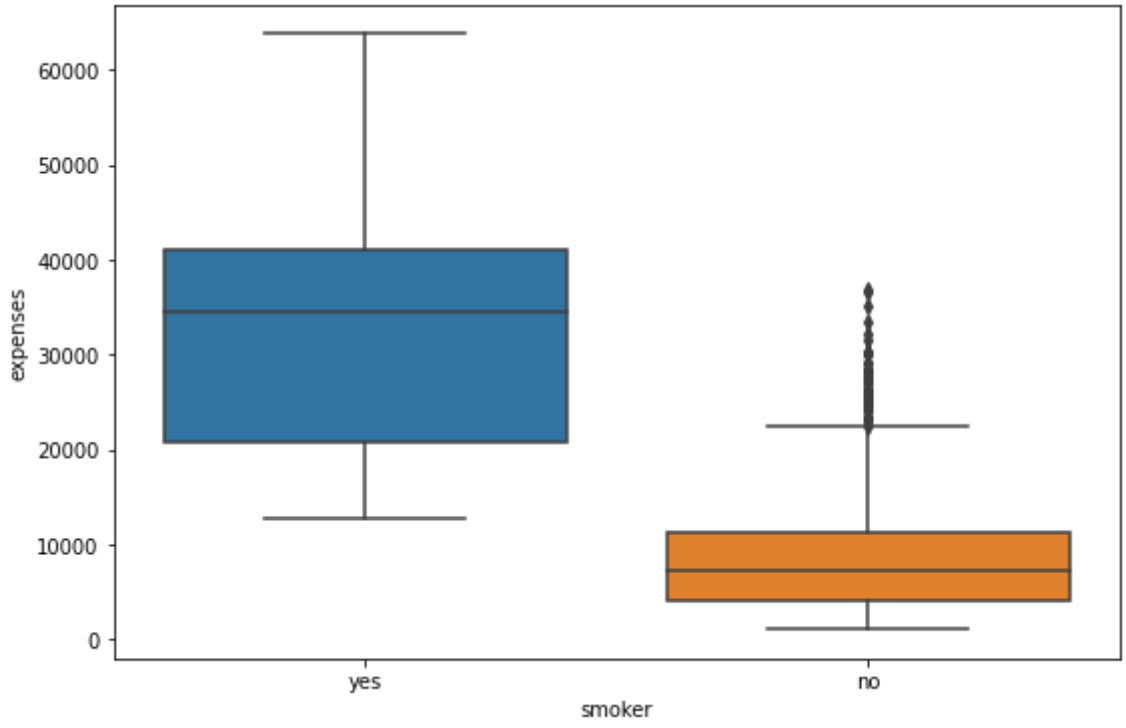



```
DF.children.value_counts()
```

```
0    574
1    324
2    240
3    157
4     25
5     18
Name: children, dtype: int64
```

4) 흡연여부 별 의료비 분포

```
plt.figure(figsize = (9, 6))
sns.boxplot(x = 'smoker', y = 'expenses', data = DF)
plt.show()
```

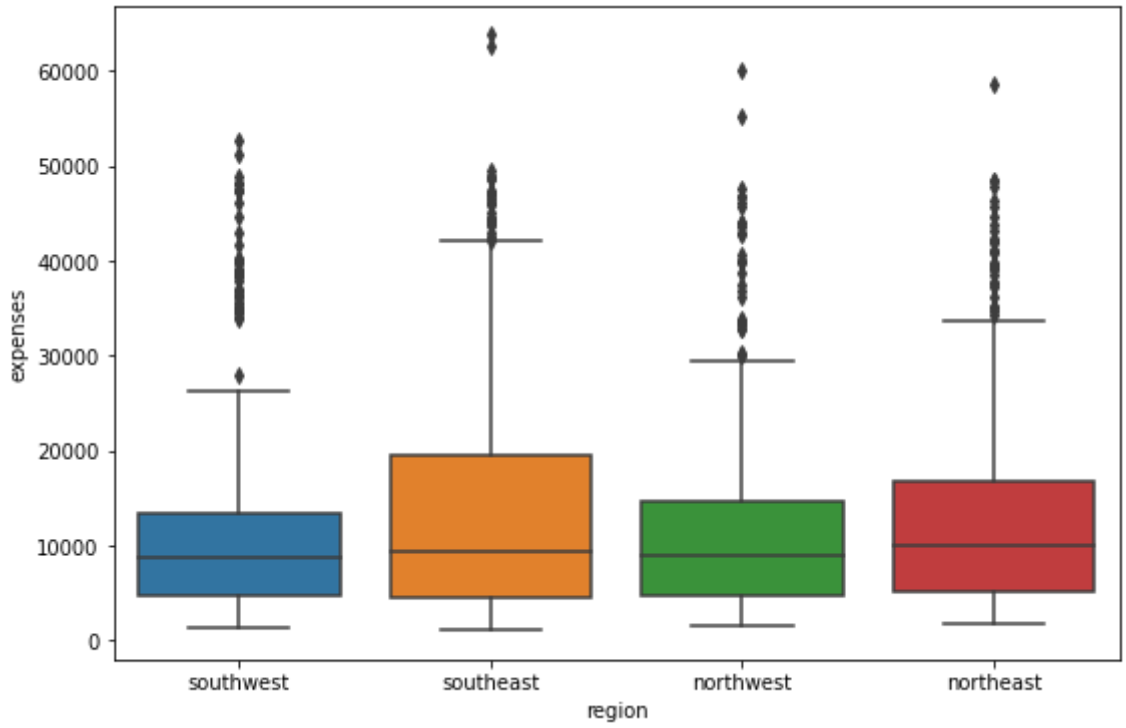



```
DF.smoker.value_counts()
```

```
no      1064
yes      274
Name: smoker, dtype: int64
```

5) 거주지역 별 의료비 분포

```
plt.figure(figsize = (9, 6))
sns.boxplot(x = 'region', y = 'expenses', data = DF)
plt.show()
```



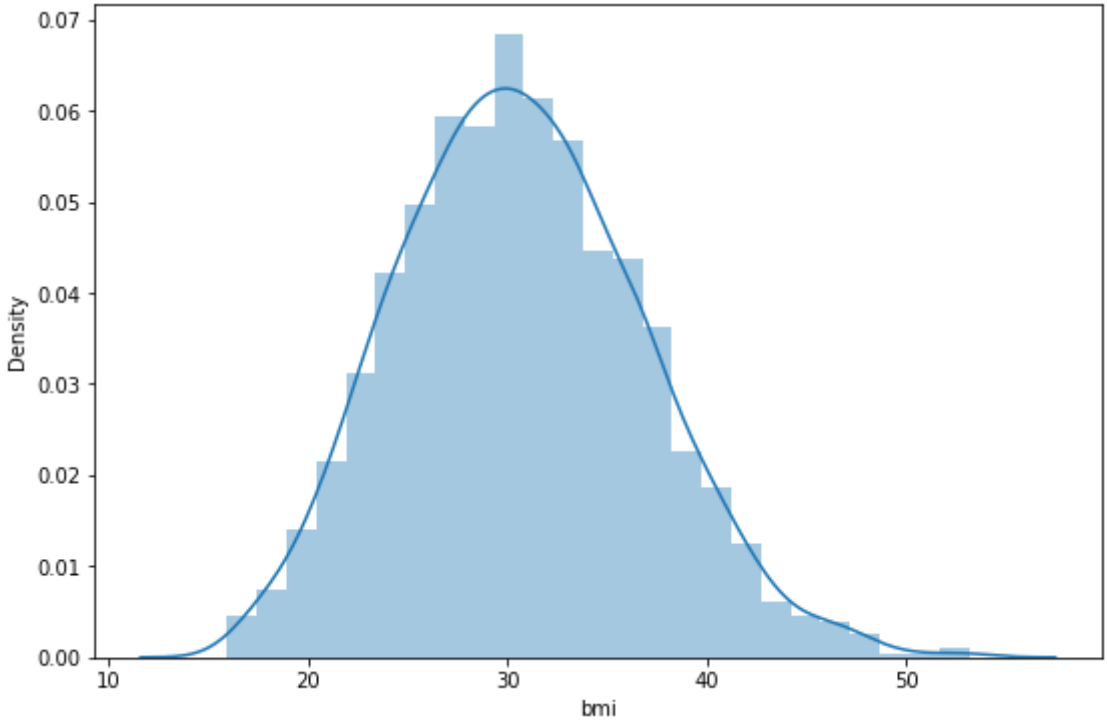

```
DF.region.value_counts()
```

```
southeast    364
southwest    325
northwest    325
northeast    324
Name: region, dtype: int64
```

6) BMI 분포 및 의료비와의 관계

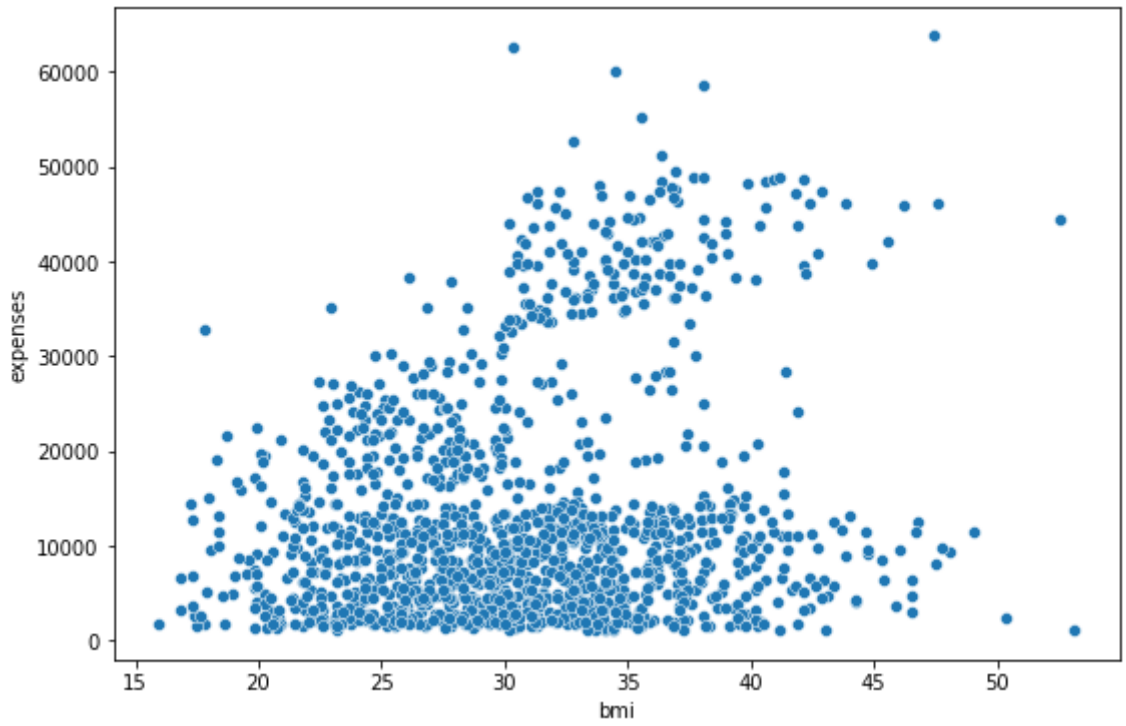
- BMI 분포

```
plt.figure(figsize = (9, 6))
sns.distplot(DF.bmi,
             hist = True,
             kde = True)
plt.show()
```



- BMI와 의료비 간의 관계

```
plt.figure(figsize = (9, 6))
sns.scatterplot(x = DF.bmi, y = DF.expenses)
plt.show()
```



II. Modeling - sklearn Package

1) Integer Encoding

- object to int64

```
DF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
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 1   sex       1338 non-null   object 
 2   bmi       1338 non-null   float64
 3   children  1338 non-null   int64  
 4   smoker    1338 non-null   object 
 5   region    1338 non-null   object 
 6   expenses  1338 non-null   float64
dtypes: float64(2), int64(2), object(3)
memory usage: 73.3+ KB
```

- LabelEncoder( )
  - 'sex', 'smoker', 'region' to int64

```
from sklearn.preprocessing import LabelEncoder

encoder1 = LabelEncoder()
DF['sex'] = encoder1.fit_transform(DF.sex)
```

```
encoder2 = LabelEncoder()
DF['smoker'] = encoder2.fit_transform(DF.smoker)
```

```
encoder3 = LabelEncoder()
DF['region'] = encoder3.fit_transform(DF.region)
```

- Encoding 결과 확인

```
DF.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1338 non-null   int64  
 1   sex       1338 non-null   int64  
 2   bmi       1338 non-null   float64
 3   children  1338 non-null   int64  
 4   smoker    1338 non-null   int64  
 5   region    1338 non-null   int64  
 6   expenses  1338 non-null   float64
```

```
dtypes: float64(2), int64(5)
memory usage: 79.9 KB
```

- 변경된 값 확인

```
DF.head()
```

	age	sex	bmi	children	smoker	region	expenses
0	19	0	27.900	0	1	3	16884.92400
1	18	1	33.770	1	0	2	1725.55230
2	28	1	33.000	3	0	2	4449.46200
3	33	1	22.705	0	0	1	21984.47061
4	32	1	28.880	0	0	1	3866.85520

2) Train & Test Array Split(7:3)

```
from sklearn.model_selection import train_test_split

X = DF[['age', 'sex']]
y = DF['expenses']

X_train, X_test, y_train, y_test = train_test_split(X, y,
                                                    test_size = 0.3,
                                                    random_state = 2045)

print('Train Data : ', X_train.shape, y_train.shape)
print('Test Data : ', X_test.shape, y_test.shape)
```

```
Train Data :  (936, 2) (936,)
Test Data :  (402, 2) (402,)
```

3) .fit( )

```
from sklearn.linear_model import LinearRegression

RA = LinearRegression()
RA.fit(X_train, y_train)
```

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)
```

4) .predict( )

```
y_hat = RA.predict(X_test)
```

5) 오차(Error)값 확인

- Mean Sqaured Error - sklearn

```
from sklearn.metrics import mean_squared_error
import numpy as np

mse2 = mean_squared_error(y_test, y_hat)

np.sqrt(mse2)
```

```
10633.607635499553
```

III. Modeling - statsmodels Package

1) Data Preprocessing

- Train & Test DataFrame Split(7:3)

```
from sklearn.model_selection import train_test_split

train_set, test_set = train_test_split(DF,
                                       test_size = 0.3,
                                       random_state = 2045)

train_set.shape, test_set.shape
```

```
((936, 7), (402, 7))
```

2) expenses ~ age + sex

- train_set으로 모델 생성
- OLS(최소자승법) : Ordinary Least Squares

```
import statsmodels.formula.api as smf

Model_1 = smf.ols(formula = 'expenses ~ age + sex',
                  data = train_set).fit()
```

3) y_hat 생성

- test_set으로 y_hat(예측값) 계산

```
y_hat_1 = Model_1.predict(test_set[['age', 'sex']])
```

4) 오차(Error)값 확인

- Mean Sqaured Error - sklearn

```
mse1 = mean_squared_error(test_set.expenses, y_hat_1)

np.sqrt(mse1)
```

```
10633.607635499553
```

IV. Package별 오차값 비교

```
print('statsmodels :', np.sqrt(mse1))
print('sklearn     :', np.sqrt(mse2))
```

```
statsmodels : 10633.607635499553
sklearn     : 10633.607635499553
```

#

#

#

The End

#

#

#