Import Liberaies

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from warnings import filterwarnings
filterwarnings('ignore')
```

Load Data

In [11]:
```
from sklearn.datasets import fetch_california_housing
```

In [14]:
```
datas = fetch_california_housing()
```

In [15]:
```
datas
```

Out[15]:
```
{'data': array([[   8.3252    ,   41.        ,    6.98412698, ...,    2.55555556,
           37.88      , -122.23      ],
        [   8.3014    ,   21.        ,    6.23813708, ...,    2.10984183,
           37.86      , -122.22      ],
        [   7.2574    ,   52.        ,    8.28813559, ...,    2.80225989,
           37.85      , -122.24      ],
        ...,
        [   1.7       ,   17.        ,    5.20554273, ...,    2.3256351 ,
           39.43      , -121.22      ],
        [   1.8672    ,   18.        ,    5.32951289, ...,    2.12320917,
           39.43      , -121.32      ],
        [   2.3886    ,   16.        ,    5.25471698, ...,    2.61698113,
           39.37      , -121.24      ]]),
 'target': array([4.526, 3.585, 3.521, ..., 0.923, 0.847, 0.894]),
 'frame': None,
 'target_names': ['MedHouseVal'],
 'feature_names': ['MedInc',
  'HouseAge',
  'AveRooms',
  'AveBedrms',
  'Population',
  'AveOccup',
  'Latitude',
  'Longitude'],
 'DESCR': '.. _california_housing_dataset:\n\nCalifornia Housing dataset\n--------------------------\n\n**Data
Set Characteristics:**\n\n:Number of Instances: 20640\n\n:Number of Attributes: 8 numeric, predictive attribute
s and the target\n\n:Attribute Information:\n    - MedInc        median income in block group\n    - HouseAge
median house age in block group\n    - AveRooms      average number of rooms per household\n    - AveBedrms
average number of bedrooms per household\n    - Population    block group population\n    - AveOccup      avera
ge number of household members\n    - Latitude      block group latitude\n    - Longitude     block group longi
tude\n\n:Missing Attribute Values: None\n\nThis dataset was obtained from the StatLib repository.\nhttps://www.
dcc.fc.up.pt/~ltorgo/Regression/cal_housing.html\n\nThe target variable is the median house value for Californi
a districts,\nexpressed in hundreds of thousands of dollars ($100,000).\n\nThis dataset was derived from the 19
90 U.S. census, using one row per census\nblock group. A block group is the smallest geographical unit for whic
h the U.S.\nCensus Bureau publishes sample data (a block group typically has a population\nof 600 to 3,000 peop
le).\n\nA household is a group of people residing within a home. Since the average\nnumber of rooms and bedroom
s in this dataset are provided per household, these\ncolumns may take surprisingly large values for block group
s with few households\nand many empty houses, such as vacation resorts.\n\nIt can be downloaded/loaded using th
e\n:func:`sklearn.datasets.fetch_california_housing` function.\n\n.. rubric:: References\n\n- Pace, R. Kelley a
nd Ronald Barry, Sparse Spatial Autoregressions,\n  Statistics and Probability Letters, 33 (1997) 291-297\n'}
```

In [22]:
```
df = pd.DataFrame(datas.data,columns=datas.feature_names)
```

In [24]:
```
df['target'] = datas.target
```

In [25]:
```
df
```

Out[25]:

	MedInc	HouseAge	AveRooms	AveBedrms	Population	AveOccup	Latitude	Longitude	target
0	8.3252	41.0	6.984127	1.023810	322.0	2.555556	37.88	-122.23	4.526
1	8.3014	21.0	6.238137	0.971880	2401.0	2.109842	37.86	-122.22	3.585
2	7.2574	52.0	8.288136	1.073446	496.0	2.802260	37.85	-122.24	3.521
3	5.6431	52.0	5.817352	1.073059	558.0	2.547945	37.85	-122.25	3.413
4	3.8462	52.0	6.281853	1.081081	565.0	2.181467	37.85	-122.25	3.422
...	...	...	...	...	...	...	...	...	...
20635	1.5603	25.0	5.045455	1.133333	845.0	2.560606	39.48	-121.09	0.781
20636	2.5568	18.0	6.114035	1.315789	356.0	3.122807	39.49	-121.21	0.771
20637	1.7000	17.0	5.205543	1.120092	1007.0	2.325635	39.43	-121.22	0.923
20638	1.8672	18.0	5.329513	1.171920	741.0	2.123209	39.43	-121.32	0.847
20639	2.3886	16.0	5.254717	1.162264	1387.0	2.616981	39.37	-121.24	0.894

20640 rows × 9 columns

Clean Data (missing values, outliers)

In [26]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 9 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   MedInc      20640 non-null  float64
 1   HouseAge    20640 non-null  float64
 2   AveRooms    20640 non-null  float64
 3   AveBedrms   20640 non-null  float64
 4   Population  20640 non-null  float64
 5   AveOccup    20640 non-null  float64
 6   Latitude    20640 non-null  float64
 7   Longitude   20640 non-null  float64
 8   target      20640 non-null  float64
dtypes: float64(9)
memory usage: 1.4 MB
```

In [53]:
```
df.describe()
```

Out[53]:

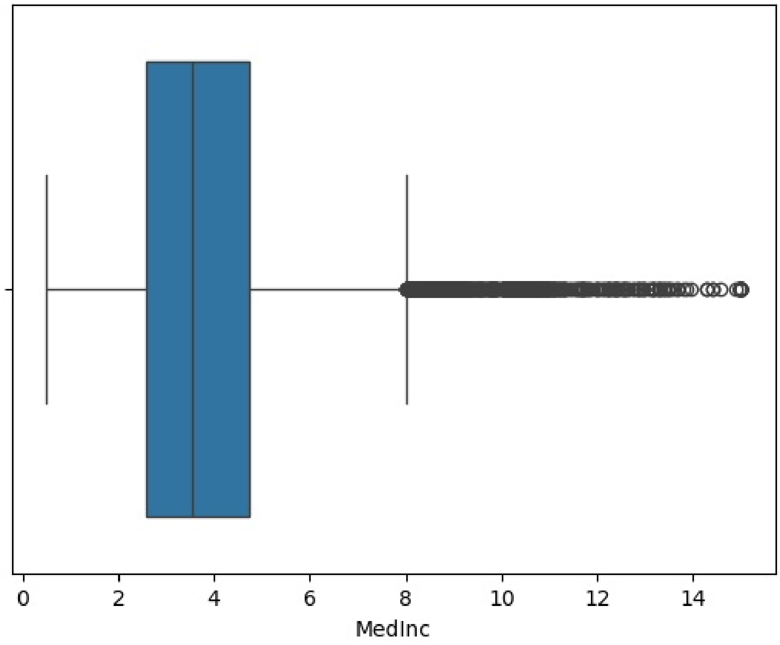
	MedInc	HouseAge	AveRooms	AveBedrms	Population	AveOccup	Latitude	Longitude	t
count	20640.000000	20640.000000	20640.000000	20640.000000	20640.000000	20640.000000	20640.000000	20640.000000	20640.00
mean	3.870671	28.639486	5.429000	1.096675	1425.476744	3.070655	35.631861	-119.569704	2.06
std	1.899822	12.585558	2.474173	0.473911	1132.462122	10.386050	2.135952	2.003532	1.15
min	0.499900	1.000000	0.846154	0.333333	3.000000	0.692308	32.540000	-124.350000	0.14
25%	2.563400	18.000000	4.440716	1.006079	787.000000	2.429741	33.930000	-121.800000	1.19
50%	3.534800	29.000000	5.229129	1.048780	1166.000000	2.818116	34.260000	-118.490000	1.79
75%	4.743250	37.000000	6.052381	1.099526	1725.000000	3.282261	37.710000	-118.010000	2.64
max	15.000100	52.000000	141.909091	34.066667	35682.000000	1243.333333	41.950000	-114.310000	5.00

In [27]:
```
df.isnull().sum()
```

Out[27]:
```
MedInc        0
HouseAge      0
AveRooms      0
AveBedrms     0
Population    0
AveOccup      0
Latitude      0
Longitude     0
target        0
dtype: int64
```

In [28]:
```
sns.boxplot(x=df['MedInc'])
```

Out[28]:
```
<Axes: xlabel='MedInc'>
```

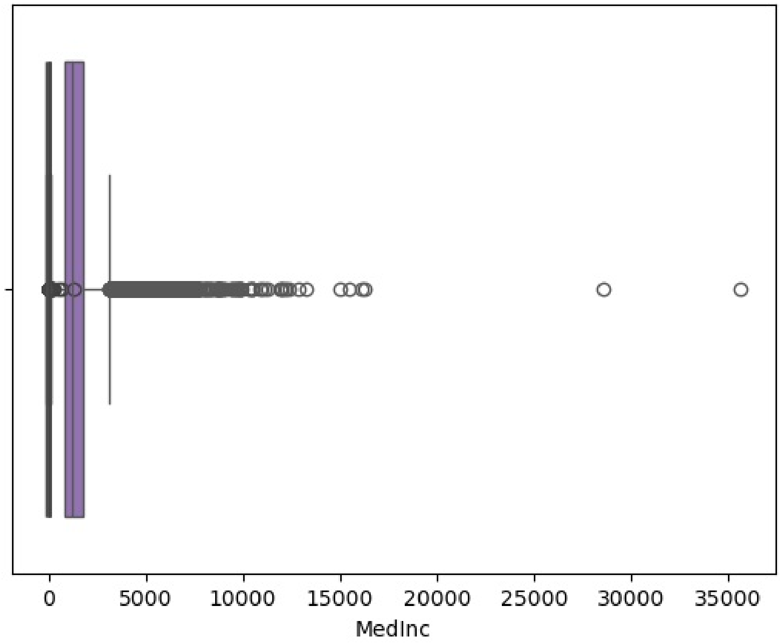


In [36]:
```
df.columns
```

Out[36]:
```
Index(['MedInc', 'HouseAge', 'AveRooms', 'AveBedrms', 'Population', 'AveOccup',
       'Latitude', 'Longitude', 'target'],
      dtype='object')
```

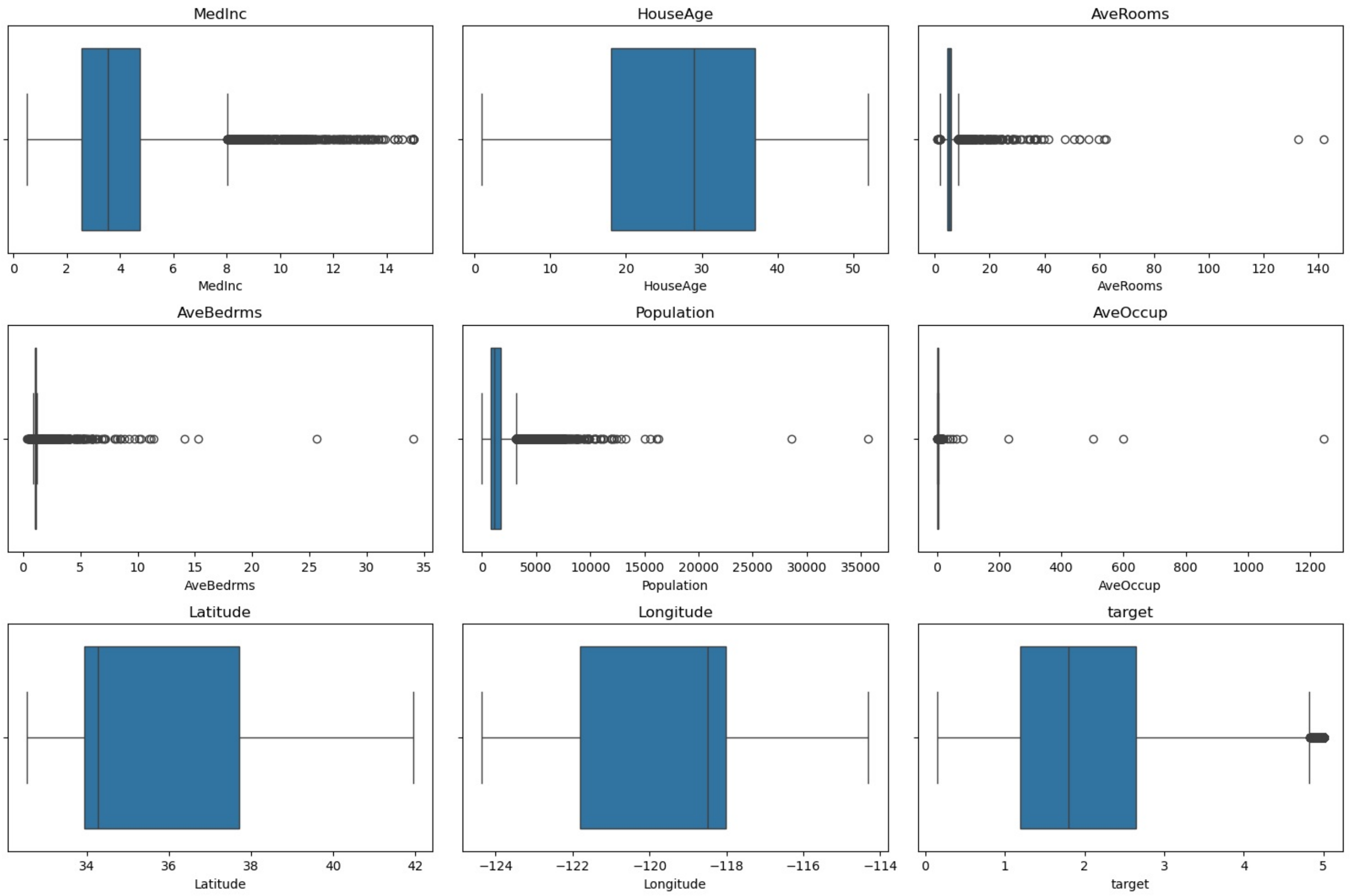
In [40]:
```
feature_columns = ['MedInc', 'HouseAge', 'AveRooms', 'AveBedrms', 'Population', 'AveOccup','Latitude', 'Longitu

for cc in feature_columns:
    sns.boxplot(x = df[cc])
```



In [46]:
```
feature_columns = ['MedInc', 'HouseAge', 'AveRooms', 'AveBedrms', 'Population', 'AveOccup','Latitude', 'Longitu

plt.figure(figsize=(15, 10))  # Bigger figure
for i, cc in enumerate(feature_columns, 1):
    plt.subplot(3, 3, i)
    sns.boxplot(x=df[cc])
    plt.title(cc)
plt.tight_layout()
plt.show()
```



In [ ]:

Segregete X and y

In [49]:
```
X = df.drop('target',axis=1)
y = df.target
```

Split Data (train/test)

In [50]:
```
from sklearn.model_selection import train_test_split
```

In [51]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=42)
```

In [52]:
```
print("X_train Shape:",X_train.shape)
print("y_train Shape:",y_train.shape)

print("-"*30)

print("X_test Shape:",X_test.shape)
print("y_test Shape:",y_test.shape)
```

```
X_train Shape: (16512, 8)
y_train Shape: (16512,)
------------------------------
X_test Shape: (4128, 8)
y_test Shape: (4128,)
```

Preprocess Features (scaling, encoding, etc.)

In [55]:
```
from sklearn.preprocessing import StandardScaler
```

In [57]:
```
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

Train Model (Linear, Logistic, Tree, etc.)

In [91]:
```
from sklearn.linear_model import LinearRegression
```

In [92]:
```
lr = LinearRegression()
lr
```

Out[92]:

```
▾ LinearRegression
LinearRegression()
```

In [93]:
```python
lr.fit(X_train_scaled,y_train)
```

Out[93]:

```
▾ LinearRegression
LinearRegression()
```

In [94]:
```python
y_pred_lr = model.predict(X_test_scaled)
```

In [95]:
```python
pd.DataFrame(y_pred_lr,columns=['Predicted'])
```

Out[95]:

	Predicted
0	0.719123
1	1.764017
2	2.709659
3	2.838926
4	2.604657
...	...
4123	1.991746
4124	2.249839
4125	4.468770
4126	1.187511
4127	2.009403

4128 rows × 1 columns

In [96]:
```python
pd.DataFrame(y_test)
```

Out[96]:

	target
20046	0.47700
3024	0.45800
15663	5.00001
20484	2.18600
9814	2.78000
...	...
15362	2.63300
16623	2.66800
18086	5.00001
2144	0.72300
3665	1.51500

4128 rows × 1 columns

In [88]:
```python
from sklearn.ensemble import RandomForestRegressor
```

In [99]:
```python
rf = RandomForestRegressor(n_estimators=100,random_state=42)
rf
```

Out[99]:

```
▾ RandomForestRegressor
RandomForestRegressor(random_state=42)
```

In [101…
```python
rf.fit(X_train,y_train)
```

Out[101…

```
▾ RandomForestRegressor
RandomForestRegressor(random_state=42)
```

In [102…
```
y_pred_rf = rf.predict(X_test)
```

In [104…
```
pd.DataFrame(y_pred_rf,columns=['Predicted'])
```

Out[104…

	Predicted
0	0.509500
1	0.741610
2	4.923257
3	2.529610
4	2.273690
...	...
4123	2.267210
4124	1.993650
4125	4.758219
4126	0.714090
4127	1.650830

4128 rows × 1 columns

In [106…
```
pd.DataFrame(y_test)
```

Out[106…

	target
20046	0.47700
3024	0.45800
15663	5.00001
20484	2.18600
9814	2.78000
...	...
15362	2.63300
16623	2.66800
18086	5.00001
2144	0.72300
3665	1.51500

4128 rows × 1 columns

Evaluate the model

In [72]:
```
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squared_error,r2_score
```

In [121…
```
print("Linear Regression")
print('-'*30)
print("Mean Squared Error : ",mean_squared_error(y_test,y_pred_lr))
print("Mean Absolute Error : ",mean_absolute_error(y_test,y_pred_lr))
print("Root Mean Squared Error : ",root_mean_squared_error(y_test,y_pred_lr))
print("R Squared : ",r2_score(y_test,y_pred_lr))
```

```
Linear Regression
------------------------------
Mean Squared Error :  0.5558915986952441
Mean Absolute Error :  0.5332001304956566
Root Mean Squared Error :  0.7455813830127762
R Squared :  0.575787706032451
```

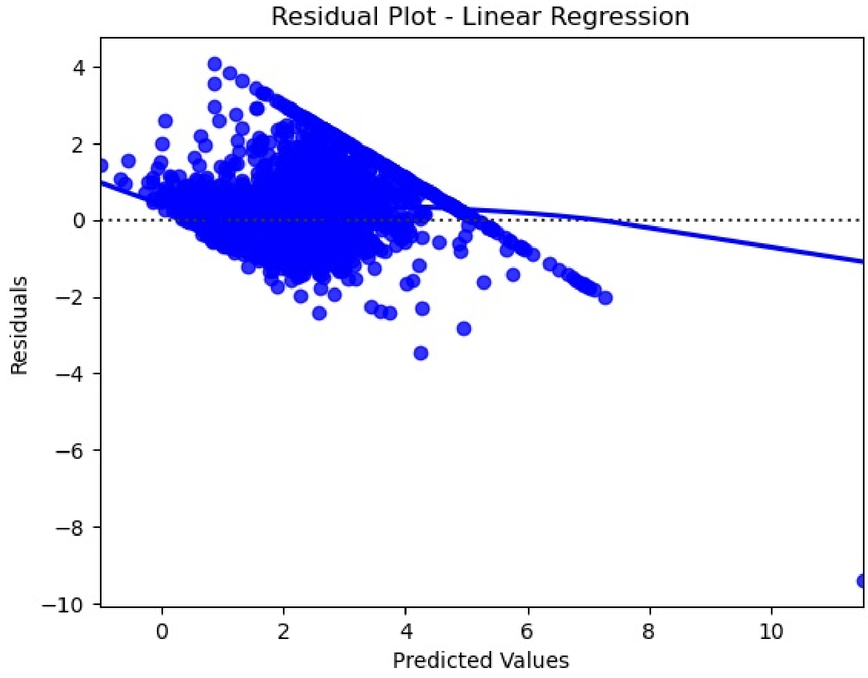
RandomForest metrics

In [123…
```
print("Random Forest")
print('-'*30)
print("Mean Squared Error : ",mean_squared_error(y_test,y_pred_rf))
print("Mean Absolute Error : ",mean_absolute_error(y_test,y_pred_rf))
print("Root Mean Squared Error : ",root_mean_squared_error(y_test,y_pred_rf))
print("R Squared : ",r2_score(y_test,y_pred_rf))
```

```
Random Forest
------------------------------
Mean Squared Error :  0.2553684927247781
Mean Absolute Error :  0.32754256845930246
Root Mean Squared Error :  0.5053399773665033
R Squared :  0.8051230593157366
```

In [108…

```python
# 1. Residual Plot for Linear Regression
sns.residplot(x=y_pred_lr, y=y_test - y_pred_lr, lowess=True, color='blue')
plt.xlabel('Predicted Values')
plt.ylabel('Residuals')
plt.title('Residual Plot - Linear Regression')
plt.show()
```



In [111…

```python
# 2. Feature Importance for Random Forest

feature_importance = pd.Series(rf.feature_importances_, index=data.feature_names)
feature_importance.nlargest(10).plot(kind='barh')
plt.title('Top 10 Feature Importances - Random Forest')
plt.xlabel('Importance Score')
plt.show()
```