```
!pip install seaborn==0.11.0
```

```
Collecting seaborn==0.11.0
  Downloading seaborn-0.11.0-py3-none-any.whl (283 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 283.1/283.1 kB 3.6 MB/s eta 0:00:00
Requirement already satisfied: numpy>=1.15 in /usr/local/lib/python3.10/dist-packages (from seaborn==0.11.0) (1.25.2)
Requirement already satisfied: scipy>=1.0 in /usr/local/lib/python3.10/dist-packages (from seaborn==0.11.0) (1.11.4)
Requirement already satisfied: pandas>=0.23 in /usr/local/lib/python3.10/dist-packages (from seaborn==0.11.0) (2.0.3)
Requirement already satisfied: matplotlib>=2.2 in /usr/local/lib/python3.10/dist-packages (from seaborn==0.11.0) (3.7.1)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (1.2.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (4.53.1)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (1.4.5)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (24.1)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (9.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (3.1.2)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=2.2->seaborn==0.11.0) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.23->seaborn==0.11.0) (2023.4)
Requirement already satisfied: tzdata>=2022.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.23->seaborn==0.11.0) (2024.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib>=2.2->seaborn==0.11.0) (1.16.0)
Installing collected packages: seaborn
  Attempting uninstall: seaborn
    Found existing installation: seaborn 0.13.1
    Uninstalling seaborn-0.13.1:
      Successfully uninstalled seaborn-0.13.1
Successfully installed seaborn-0.11.0
```

```
import pandas as pd
```

```
import pandas.io.json as pd_json
```

```
import json
import pandas as pd # Import pandas at the top level
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import SVC, LinearSVC
from sklearn.ensemble import ExtraTreesClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier , GradientBoostingClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC

from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report

from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier , GradientBoostingClassifier

# Use pd.json_normalize directly



import pandas as pd

local = '/content/data.csv'
df = pd.read_csv(local, encoding='latin-1', index_col=0)
```

```
columns_list = [
 'radius_mean',
 'texture_mean',
 'perimeter_mean',
 'area_mean',
 'smoothness_mean',
 'compactness_mean',
 'concavity_mean',
 'concave points_mean',
 'symmetry_mean',
 'fractal_dimension_mean',
 'radius_se',
 'texture_se',
 'perimeter_se',
 'area_se',
 'smoothness_se',
 'compactness_se',
 'concavity_se',
 'concave points_se',
 'symmetry_se',
 'fractal_dimension_se',
 'radius_worst',
 'texture_worst',
 'perimeter_worst',
 'area_worst',
 'smoothness_worst',
 'compactness_worst',
 'concavity_worst',
 'concave points_worst',
 'symmetry_worst',
 'fractal_dimension_worst',
 'diagnosis']


df = df[columns_list]
cm = sns.light_palette("green", as_cmap=True)
df.head(30).style.background_gradient(cmap=cm)
```

id	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean
842302	17.990000	10.380000	122.800000	1001.000000	0.118400	0.277600	0.300100	0.147100
842517	20.570000	17.770000	132.900000	1326.000000	0.084740	0.078640	0.086900	0.070170
84300903	19.690000	21.250000	130.000000	1203.000000	0.109600	0.159900	0.197400	0.127900
84348301	11.420000	20.380000	77.580000	386.100000	0.142500	0.283900	0.241400	0.105200
84358402	20.290000	14.340000	135.100000	1297.000000	0.100300	0.132800	0.198000	0.104300
843786	12.450000	15.700000	82.570000	477.100000	0.127800	0.170000	0.157800	0.080890
844359	18.250000	19.980000	119.600000	1040.000000	0.094630	0.109000	0.112700	0.074000
84458202	13.710000	20.830000	90.200000	577.900000	0.118900	0.164500	0.093660	0.059850
844981	13.000000	21.820000	87.500000	519.800000	0.127300	0.193200	0.185900	0.093530
84501001	12.460000	24.040000	83.970000	475.900000	0.118600	0.239600	0.227300	0.085430
845636	16.020000	23.240000	102.700000	797.800000	0.082060	0.066690	0.032990	0.033230
84610002	15.780000	17.890000	103.600000	781.000000	0.097100	0.129200	0.099540	0.066060
846226	19.170000	24.800000	132.400000	1123.000000	0.097400	0.245800	0.206500	0.111800
846381	15.850000	23.950000	103.700000	782.700000	0.084010	0.100200	0.099380	0.053640
84667401	13.730000	22.610000	93.600000	578.300000	0.113100	0.229300	0.212800	0.080250
84799002	14.540000	27.540000	96.730000	658.800000	0.113900	0.159500	0.163900	0.073640
848406	14.680000	20.130000	94.740000	684.500000	0.098670	0.072000	0.073950	0.052590
84862001	16.130000	20.680000	108.100000	798.800000	0.117000	0.202200	0.172200	0.102800
849014	19.810000	22.150000	130.000000	1260.000000	0.098310	0.102700	0.147900	0.094980
8510426	13.540000	14.360000	87.460000	566.300000	0.097790	0.081290	0.066640	0.047810
8510653	13.080000	15.710000	85.630000	520.000000	0.107500	0.127000	0.045680	0.031100
8510824	9.504000	12.440000	60.340000	273.900000	0.102400	0.064920	0.029560	0.020760
8511133	15.340000	14.260000	102.500000	704.400000	0.107300	0.213500	0.207700	0.097560
851509	21.160000	23.040000	137.200000	1404.000000	0.094280	0.102200	0.109700	0.086320
852552	16.650000	21.380000	110.000000	904.600000	0.112100	0.145700	0.152500	0.091700
852631	17.140000	16.400000	116.000000	912.700000	0.118600	0.227600	0.222900	0.140100
852763	14.580000	21.530000	97.410000	644.800000	0.105400	0.186800	0.142500	0.087830
852781	18.610000	20.250000	122.100000	1094.000000	0.094400	0.106600	0.149000	0.077310

852973	15.300000	25.270000	102.400000	732.400000	0.108200	0.169700	0.168300	0.087510
853201	17.570000	15.050000	115.000000	955.100000	0.098470	0.115700	0.098750	0.079530

```
df.shape
pd.isnull(df).sum() > 0
```

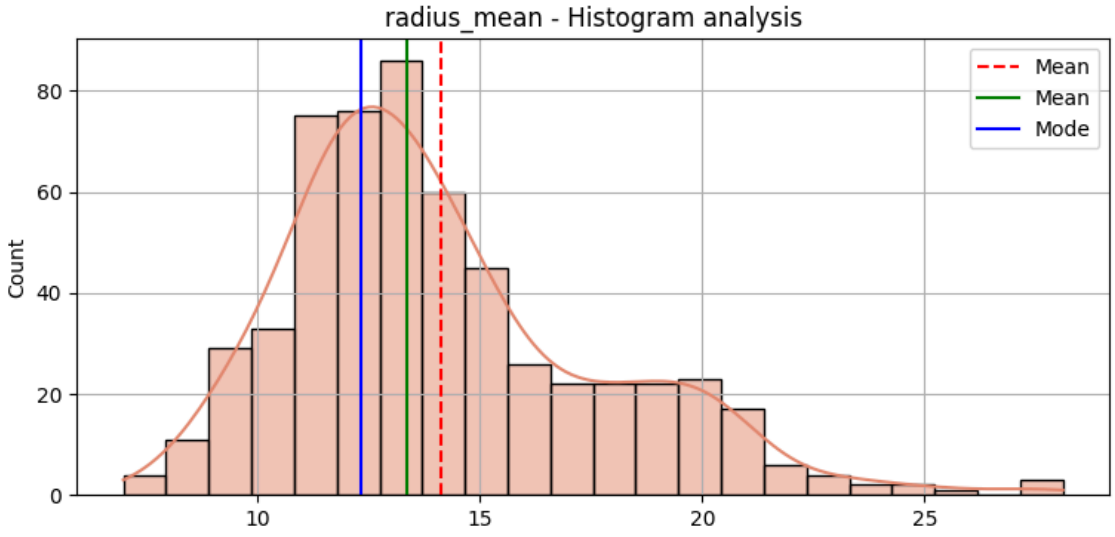
```
radius_mean               False
texture_mean              False
perimeter_mean            False
area_mean                 False
smoothness_mean           False
compactness_mean          False
concavity_mean            False
concave points_mean       False
symmetry_mean             False
fractal_dimension_mean    False
radius_se                 False
texture_se                False
perimeter_se              False
area_se                   False
smoothness_se             False
compactness_se            False
concavity_se              False
concave points_se         False
symmetry_se               False
fractal_dimension_se      False
radius_worst              False
texture_worst             False
perimeter_worst           False
area_worst                False
smoothness_worst          False
compactness_worst         False
concavity_worst           False
concave points_worst      False
symmetry_worst            False
fractal_dimension_worst   False
diagnosis                 False
dtype: bool
```

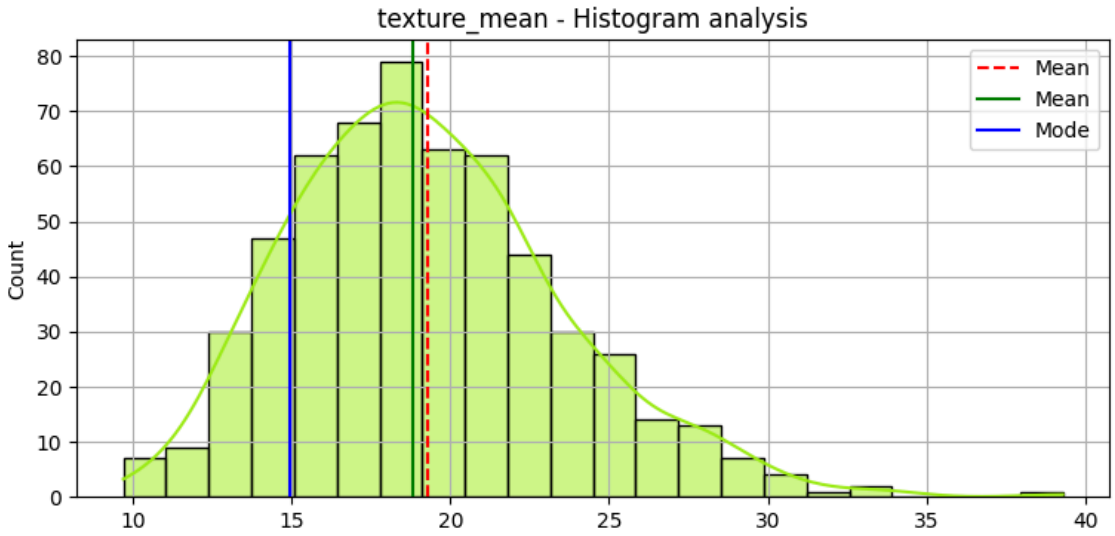
```
features = list(df.columns)
features = features[0:-1]
features
```

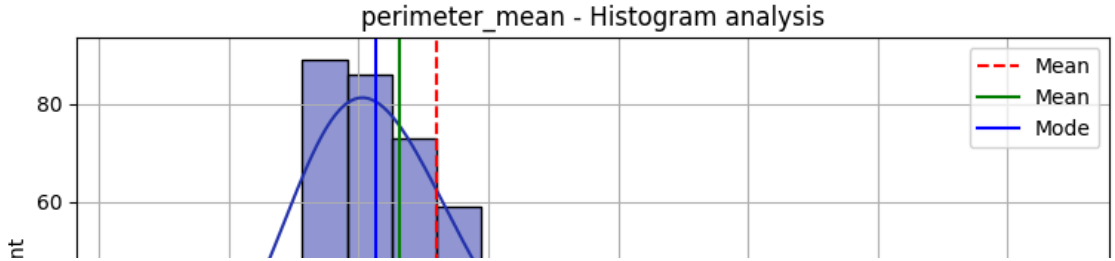
```
['radius_mean',
 'texture_mean',
 'perimeter_mean',
 'area_mean',
 'smoothness_mean',
 'compactness_mean',
 'concavity_mean',
 'concave points_mean',
```

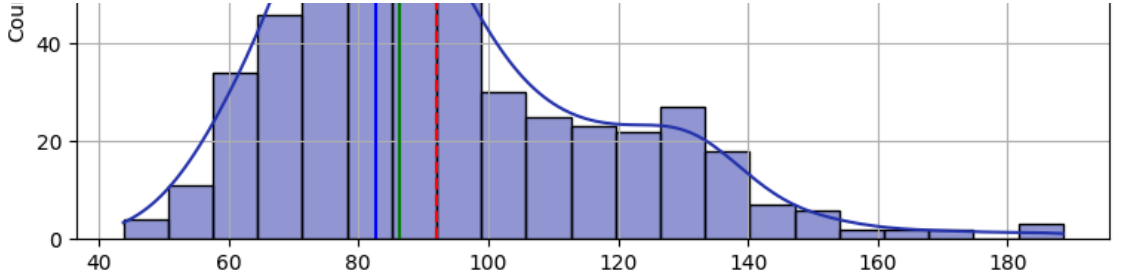
```
        'symmetry_mean',
        'fractal_dimension_mean',
        'radius_se',
        'texture_se',
        'perimeter_se',
        'area_se',
        'smoothness_se',
        'compactness_se',
        'concavity_se',
        'concave points_se',
        'symmetry_se',
        'fractal_dimension_se',
        'radius_worst',
        'texture_worst',
        'perimeter_worst',
        'area_worst',
        'smoothness_worst',
        'compactness_worst',
        'concavity_worst',
        'concave points_worst',
        'symmetry_worst',
        'fractal_dimension_worst']


import random

def get_random_color():
    r1 = lambda: random.randint(0,255)
    return '#%02X%02X%02X' % (r1(),r1(),r1())


def get_histplot_central_tendency(df: dict, fields: list):
    for field in fields:
        f, (ax1) = plt.subplots(1, 1, figsize=(9, 4))
        v_dist_1 = df[field].values
        sns.histplot(v_dist_1, ax=ax1, color=get_random_color(), kde=True)

        mean=df[field].mean()
        median=df[field].median()
        mode=df[field].mode().values[0]

        ax1.axvline(mean, color='r', linestyle='--', label="Mean")
        ax1.axvline(median, color='g', linestyle='-', label="Mean")
        ax1.axvline(mode, color='b', linestyle='-', label="Mode")
        ax1.legend()
        plt.grid()
        plt.title(f"{field} - Histogram analysis")


get_histplot_central_tendency(df, features)
```

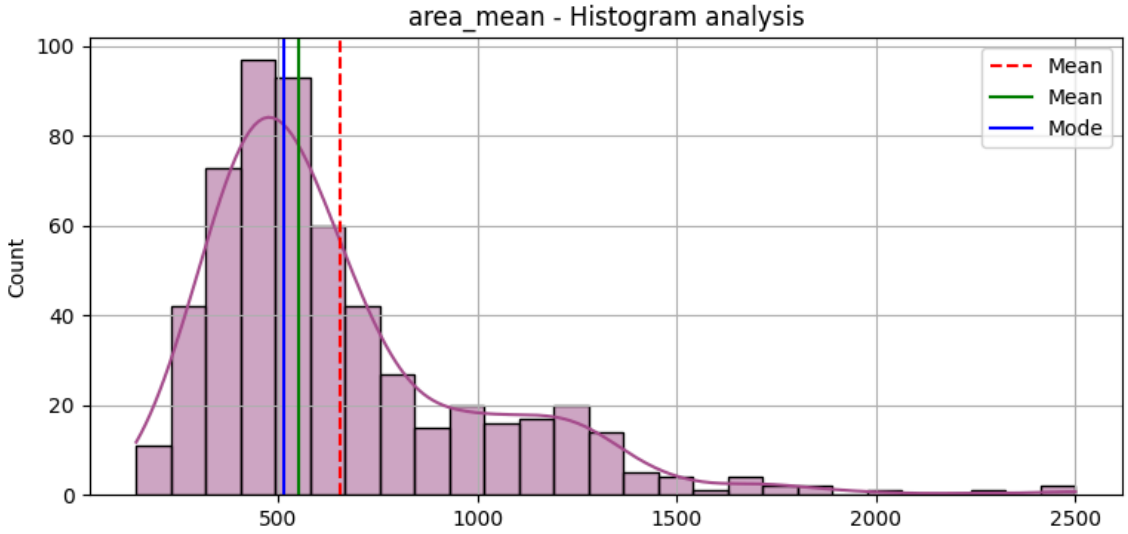
```
<ipython-input-17-b8084809e78d>:10: RuntimeWarning: More than 20 figures have been opened. Figures created through the pyplot ir
  f, (ax1) = plt.subplots(1, 1, figsize=(9, 4))
```

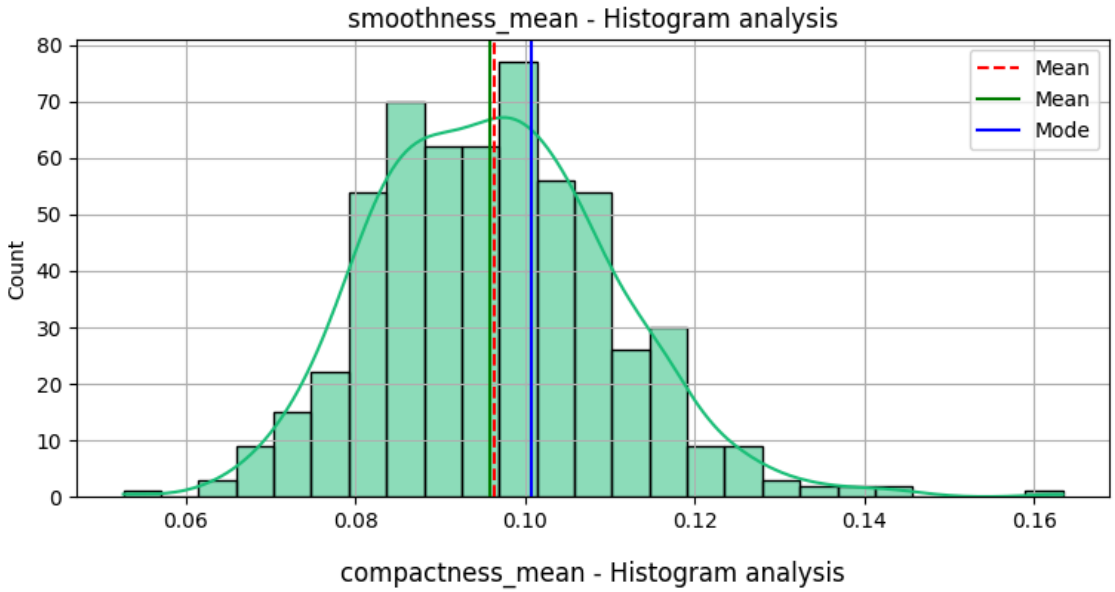




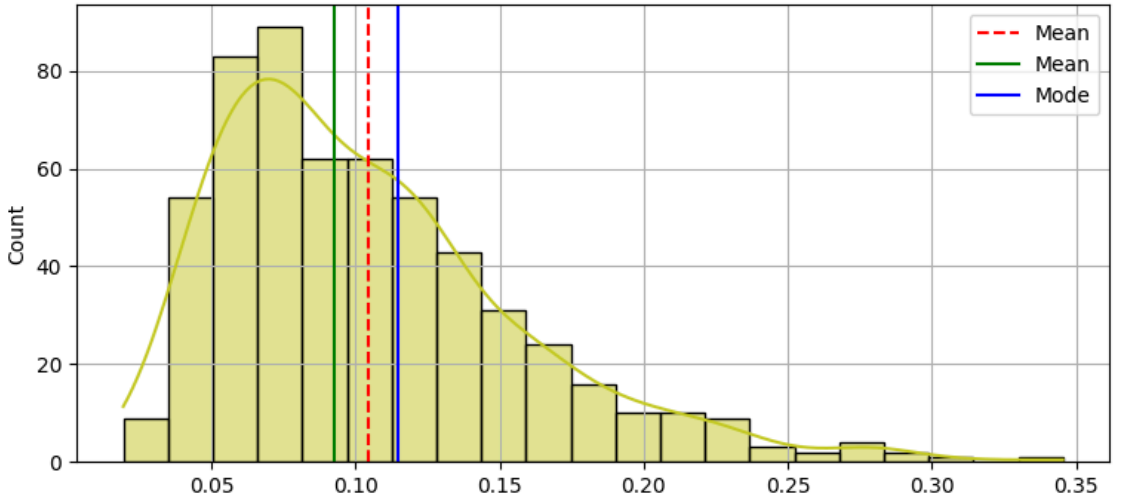


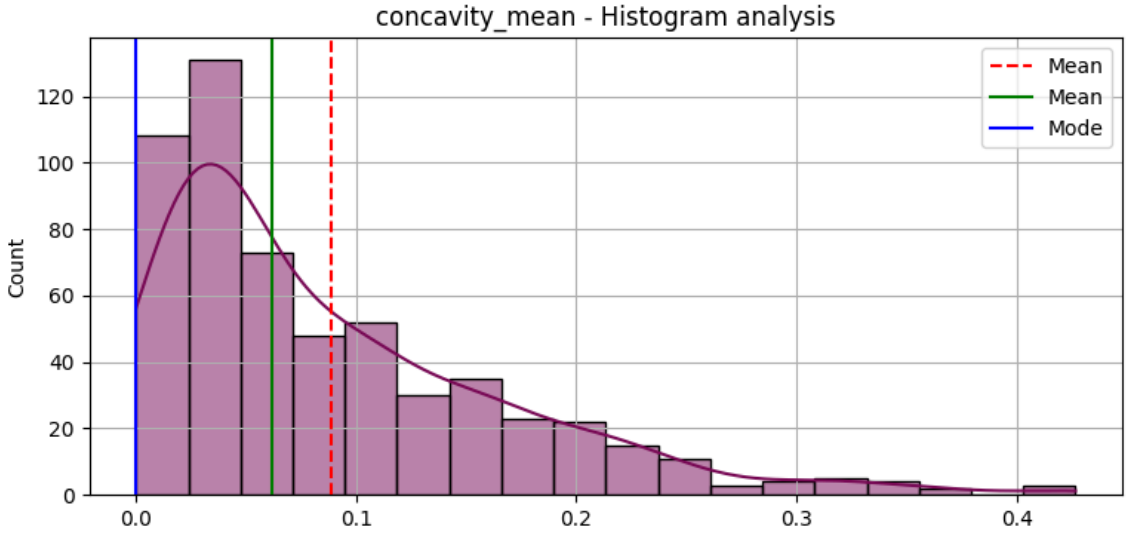


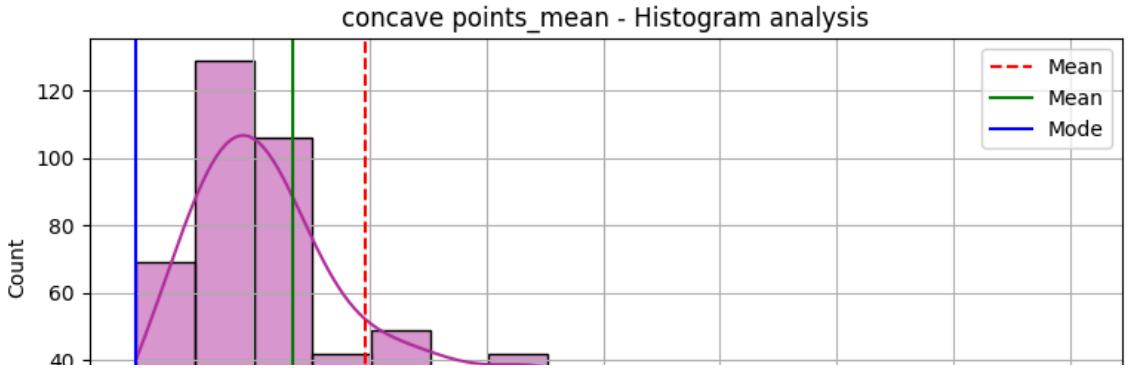


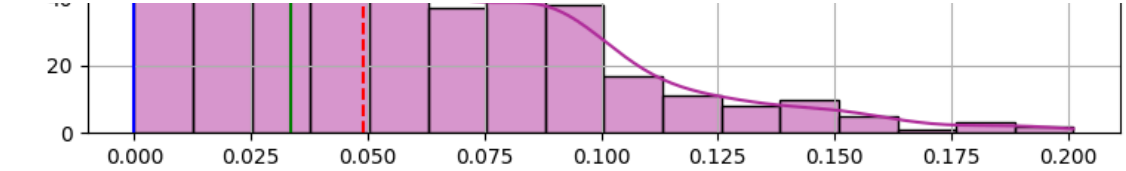


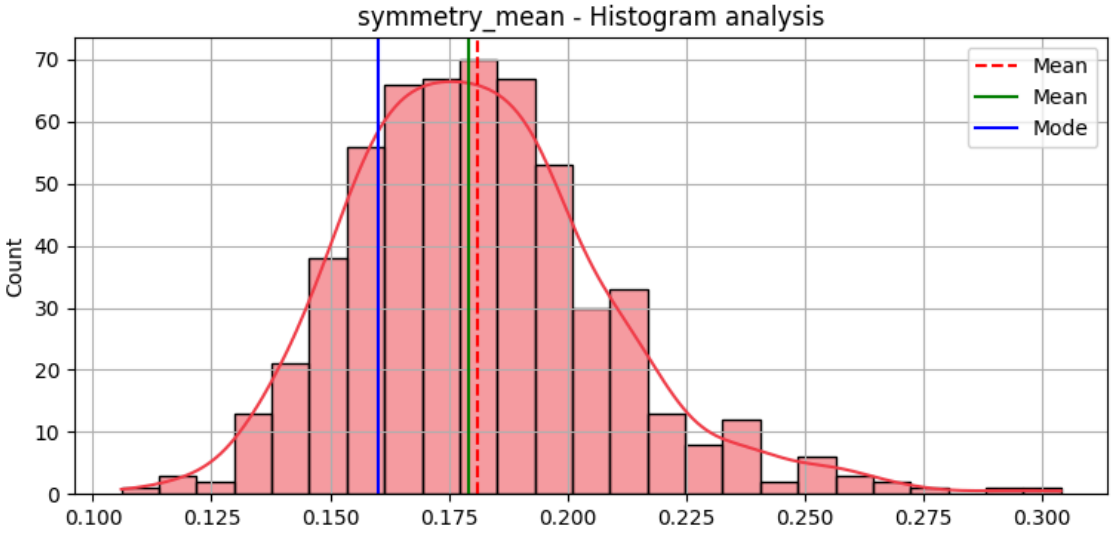
compactness_mean - Histogram analysis

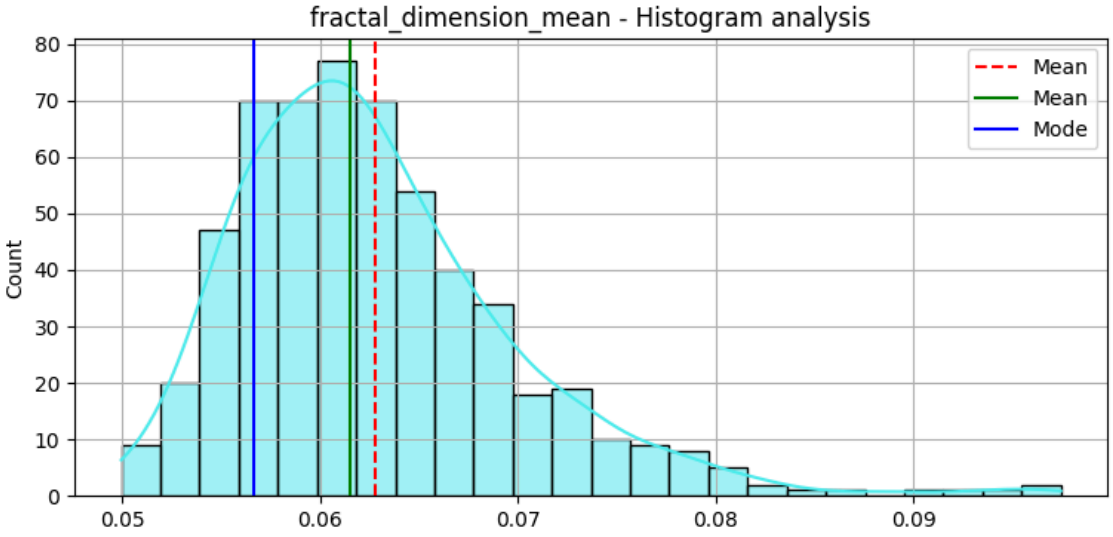

Mean
Mean
Mode
Count
0
20
40
60
80
0.05
0.10
0.15
0.20
0.25
0.30
0.35

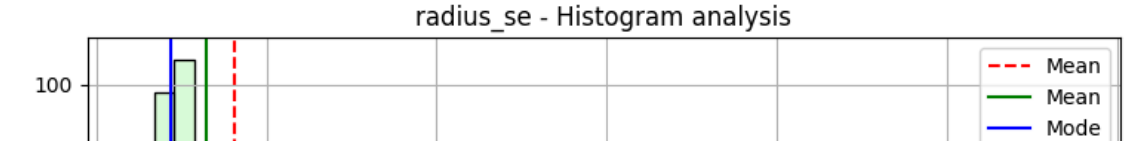

concavity_mean - Histogram analysis
Mean
Mean
Mode
Count
0
20
40
60
80
100
120
0.0
0.1
0.2
0.3
0.4

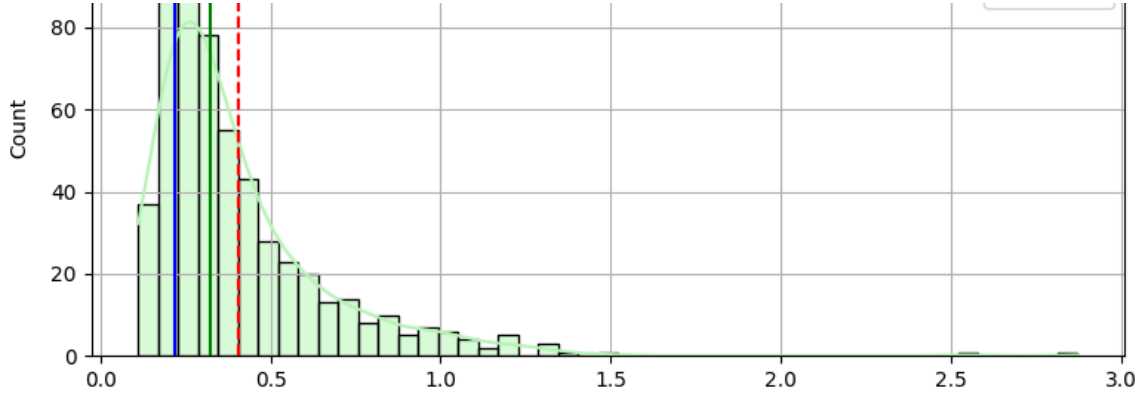

concave points_mean - Histogram analysis
Mean
Mean
Mode
Count
40
60
80
100
120

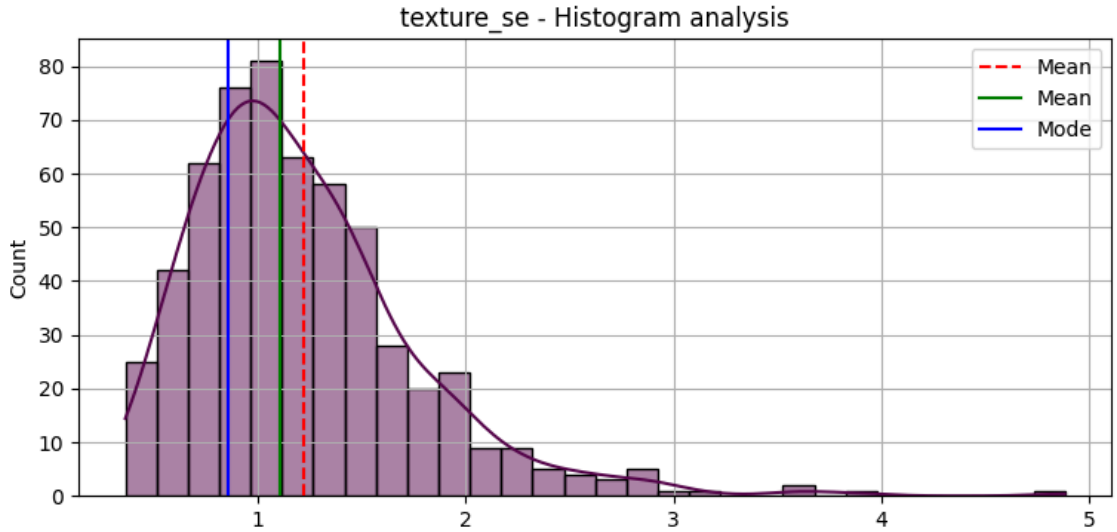

20
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200

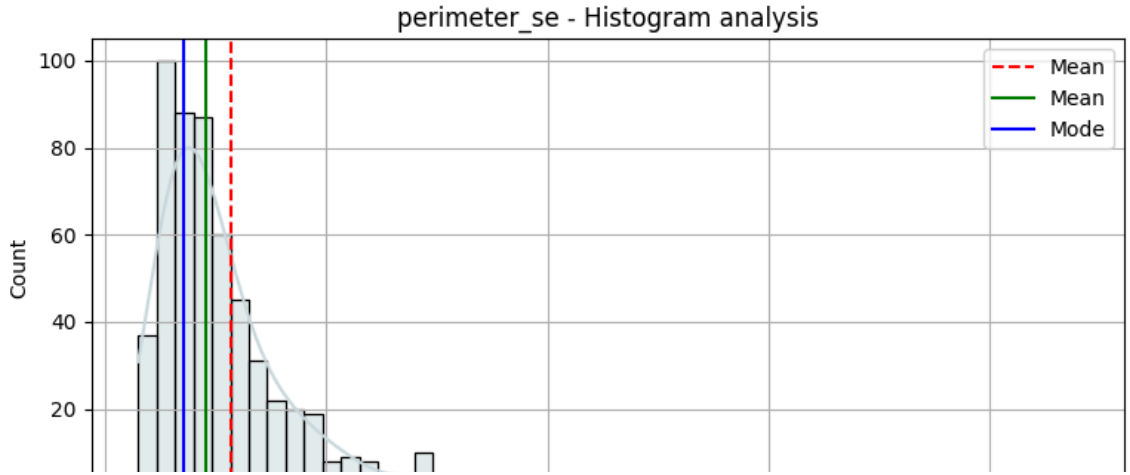

symmetry_mean - Histogram analysis
Mean
Mean
Mode
Count
70
60
50
40
30
20
10
0
0.100
0.125
0.150
0.175
0.200
0.225
0.250
0.275
0.300

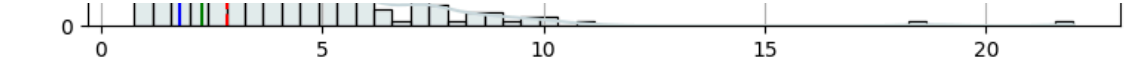

fractal_dimension_mean - Histogram analysis
Mean
Mean
Mode
Count
80
70
60
50
40
30
20
10
0
0.05
0.06
0.07
0.08
0.09

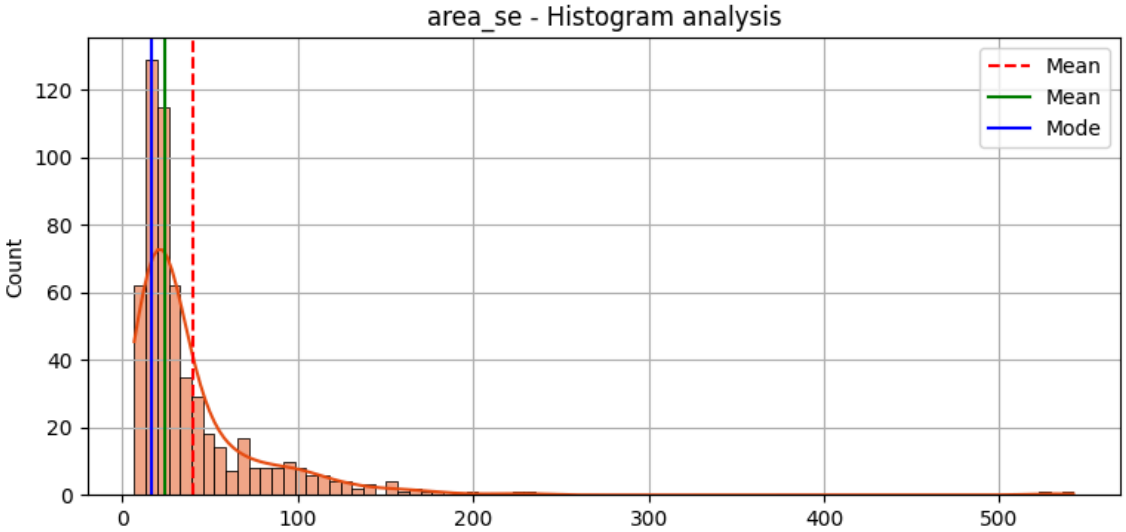

radius_se - Histogram analysis
Mean
Mean
Mode
100

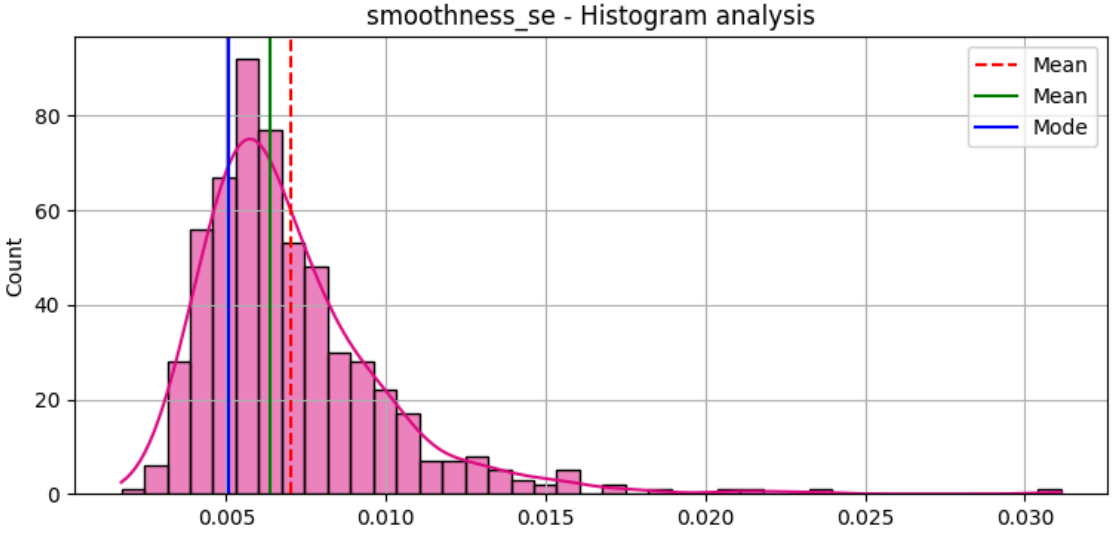

Count
0
20
40
60
80
0.0
0.5
1.0
1.5
2.0
2.5
3.0

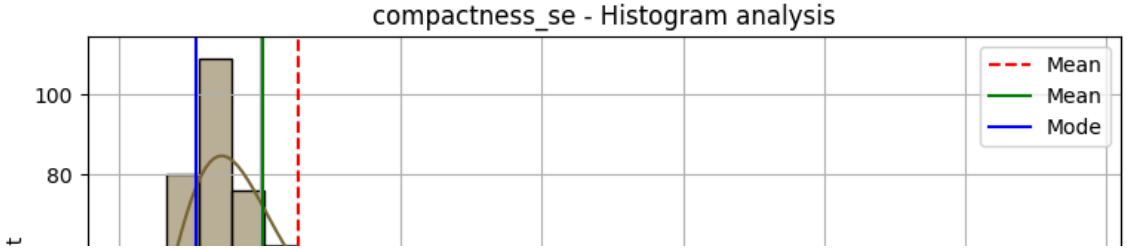

texture_se - Histogram analysis
Mean
Mean
Mode
Count
0
10
20
30
40
50
60
70
80
1
2
3
4
5

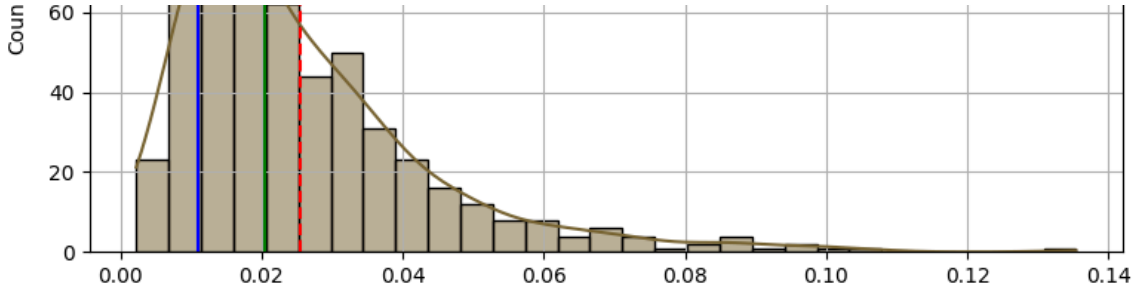

perimeter_se - Histogram analysis
Mean
Mean
Mode
Count
20
40
60
80
100

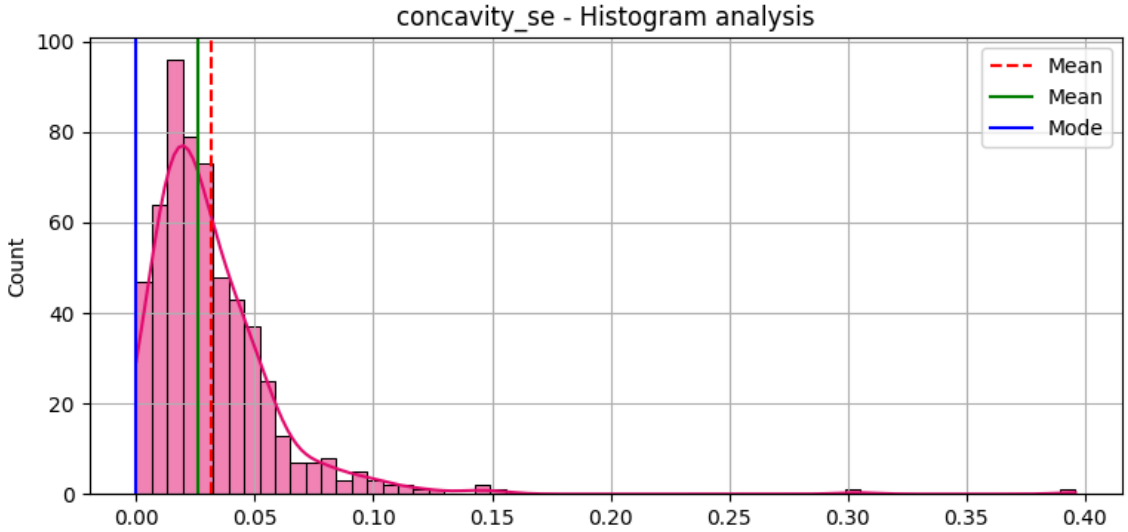

0
0
5
10
15
20

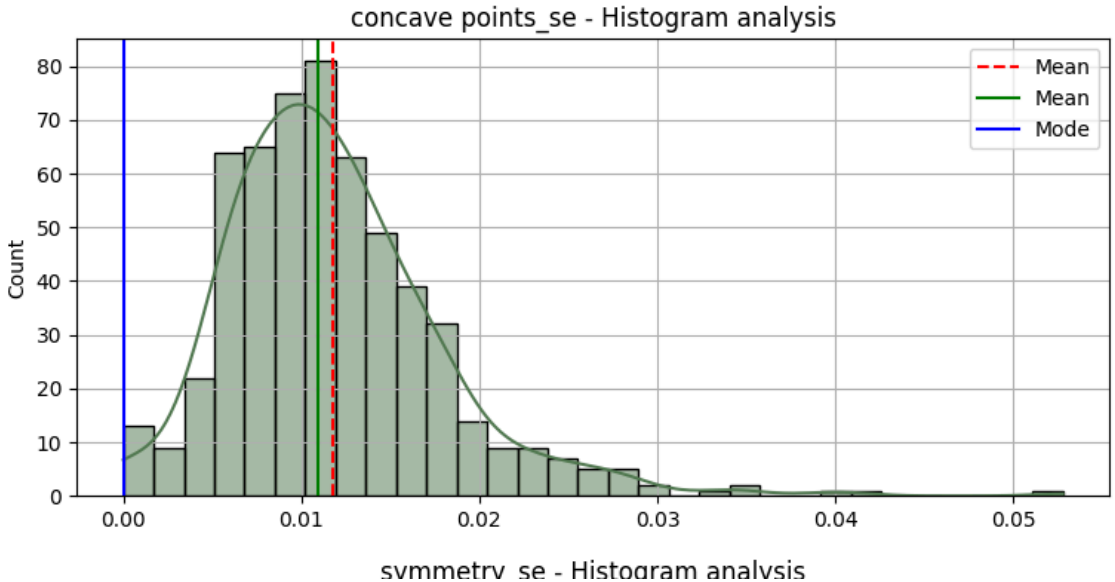

area_se - Histogram analysis
Mean
Mean
Mode
Count
0
20
40
60
80
100
120
0
100
200
300
400
500


smoothness_se - Histogram analysis
Mean
Mean
Mode
Count
0
20
40
60
80
0.005
0.010
0.015
0.020
0.025
0.030

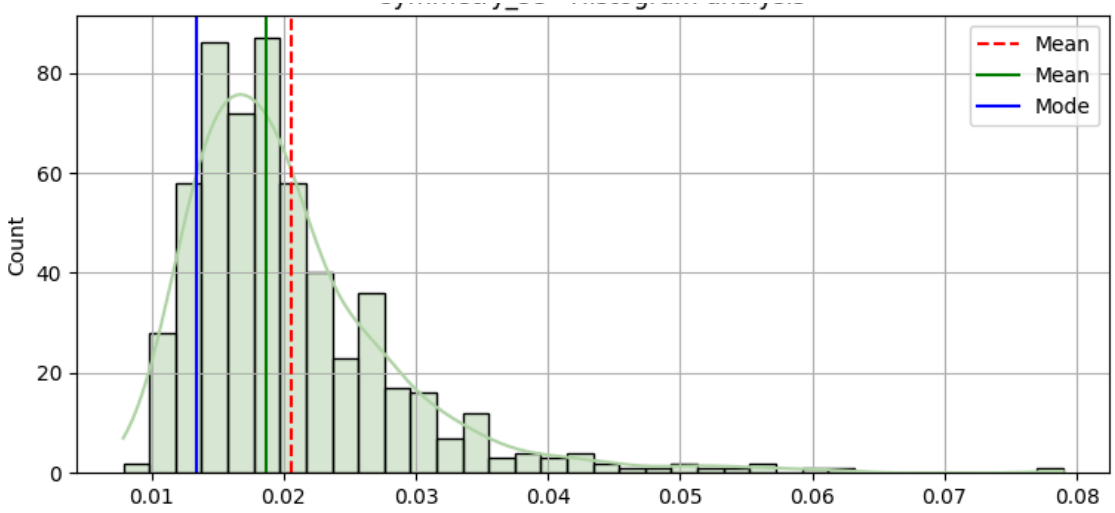

compactness_se - Histogram analysis
Mean
Mean
Mode
80
100

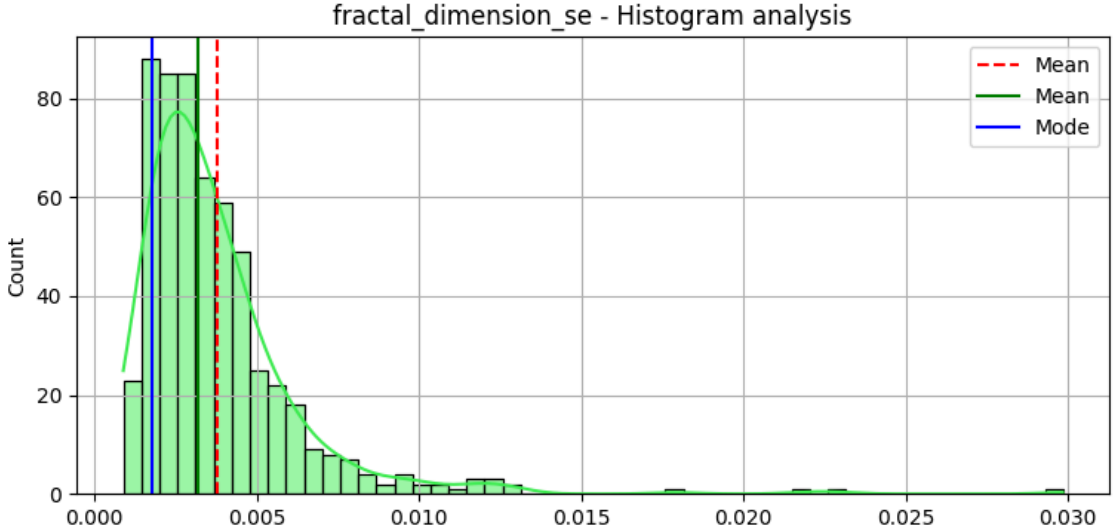


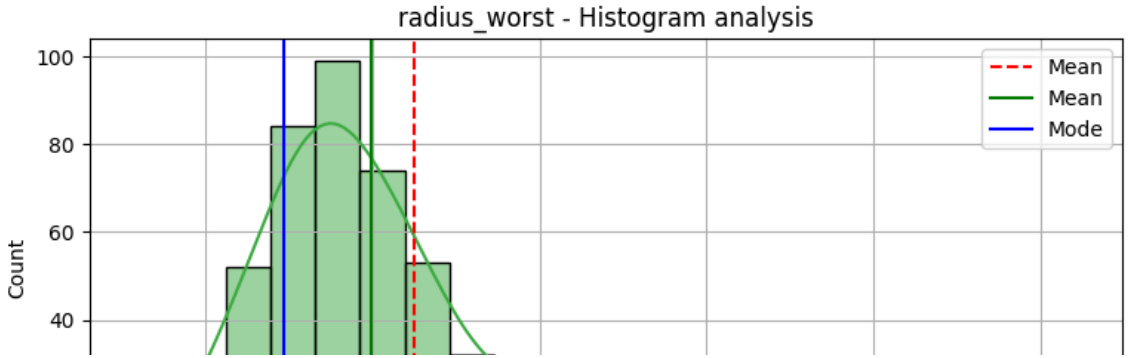


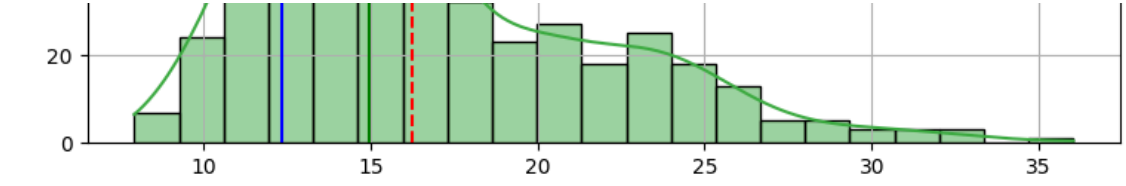


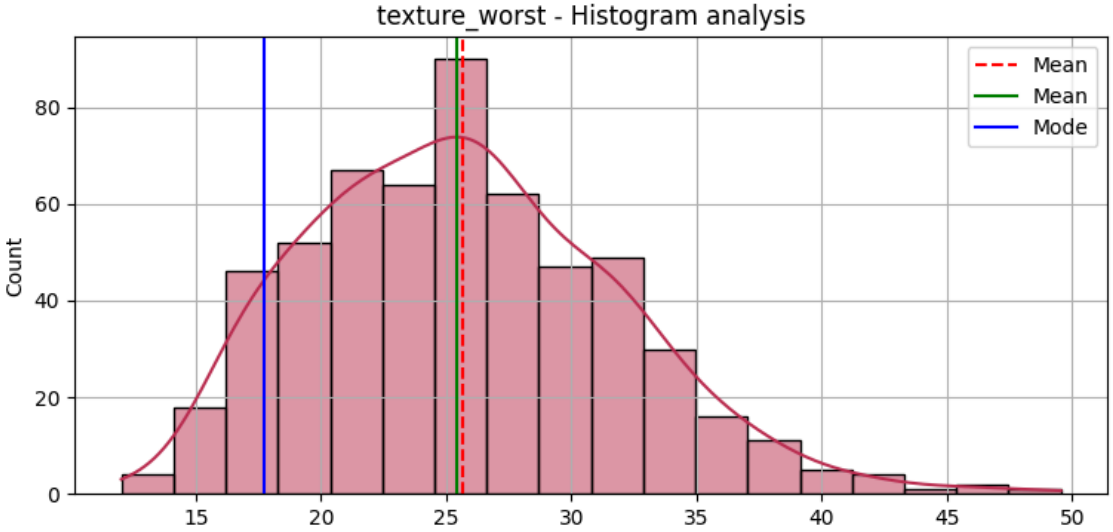
symmetry_se - Histogram analysis

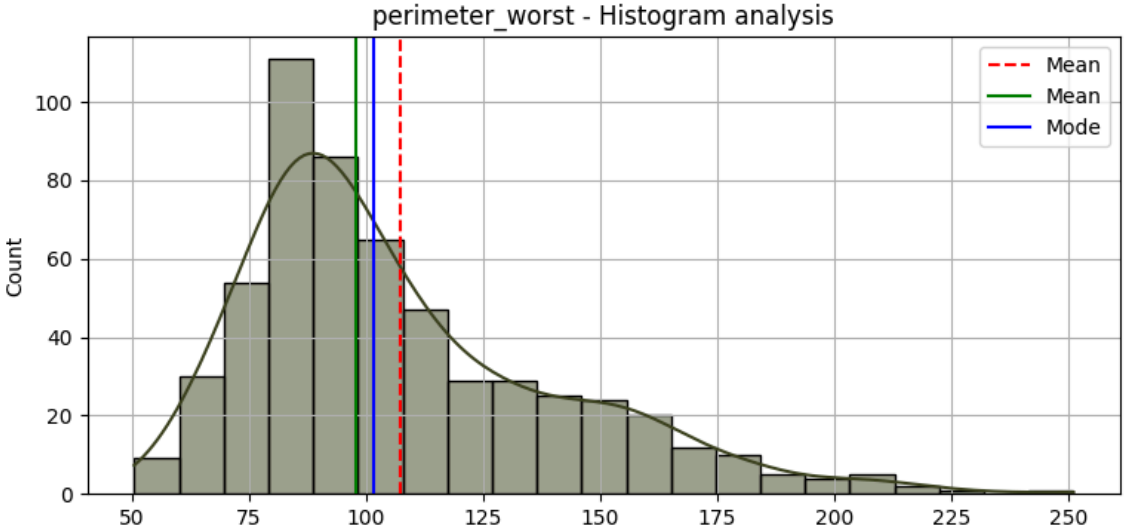

Mean
Mean
Mode
Count
0
20
40
60
80
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08


fractal_dimension_se - Histogram analysis
Mean
Mean
Mode
Count
0
20
40
60
80
0.000
0.005
0.010
0.015
0.020
0.025
0.030

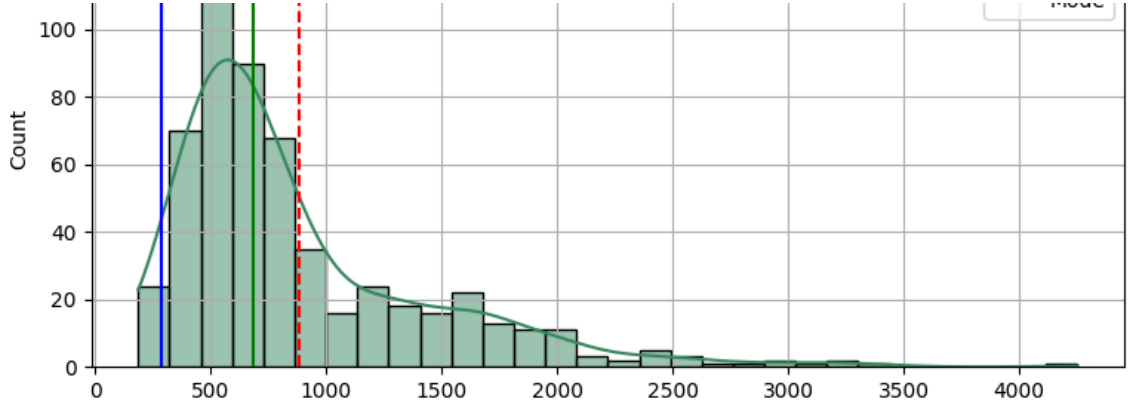

radius_worst - Histogram analysis
Mean
Mean
Mode
Count
40
60
80
100

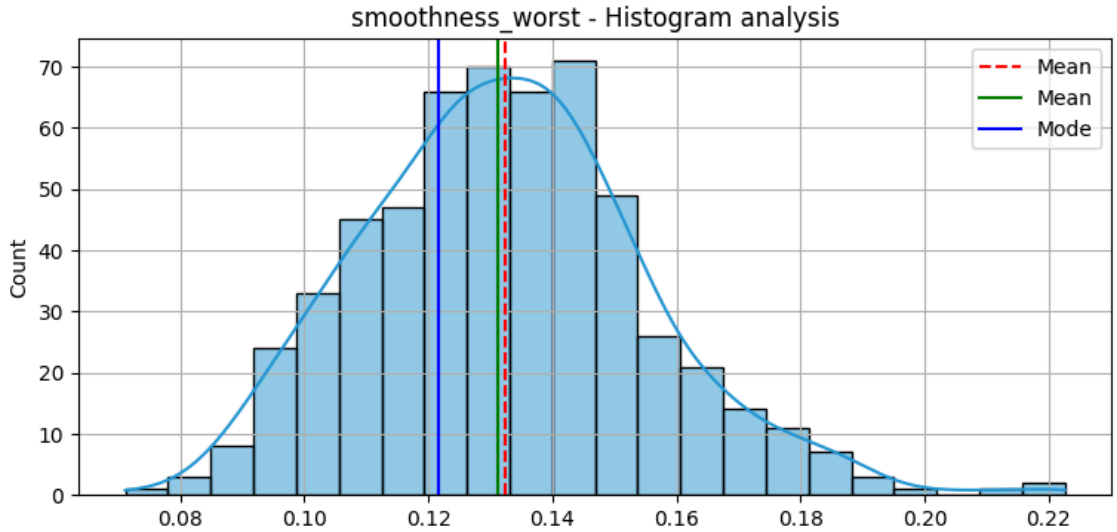

20
0
10
15
20
25
30
35

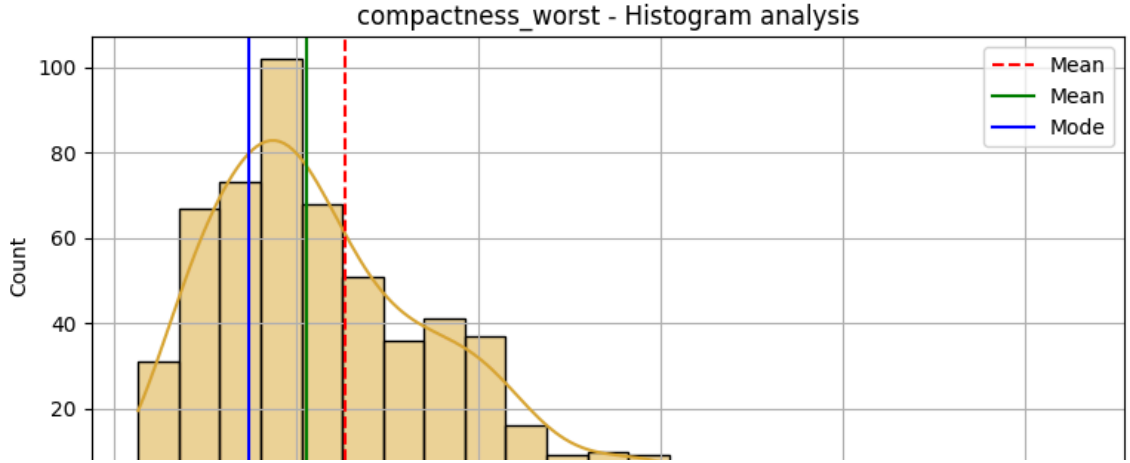

texture_worst - Histogram analysis
Mean
Mean
Mode
Count
80
60
40
20
0
15
20
25
30
35
40
45
50


perimeter_worst - Histogram analysis
Mean
Mean
Mode
Count
100
80
60
40
20
0
50
75
100
125
150
175
200
225
250

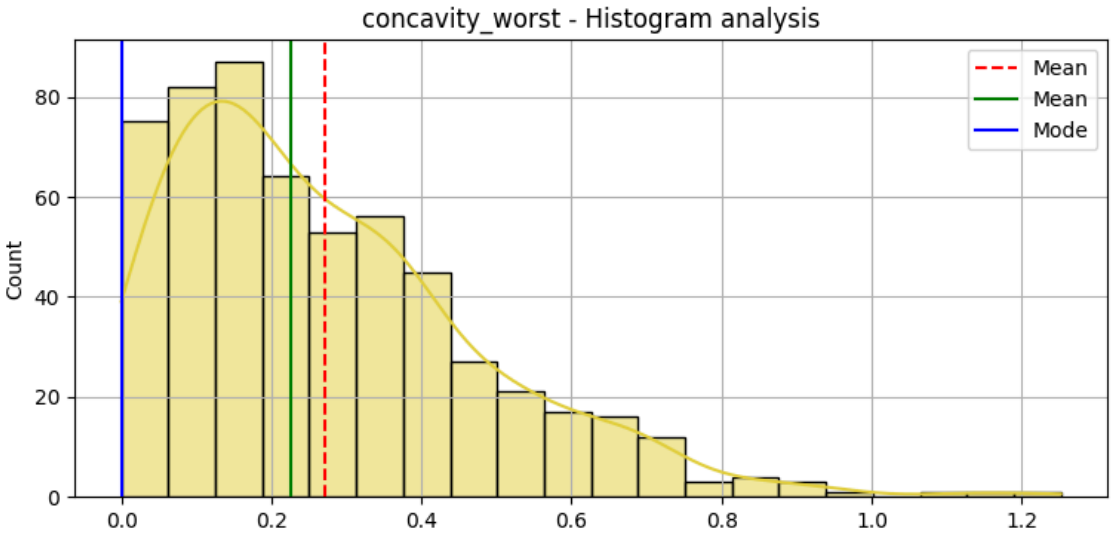

area_worst - Histogram analysis
Mean
Mean
120

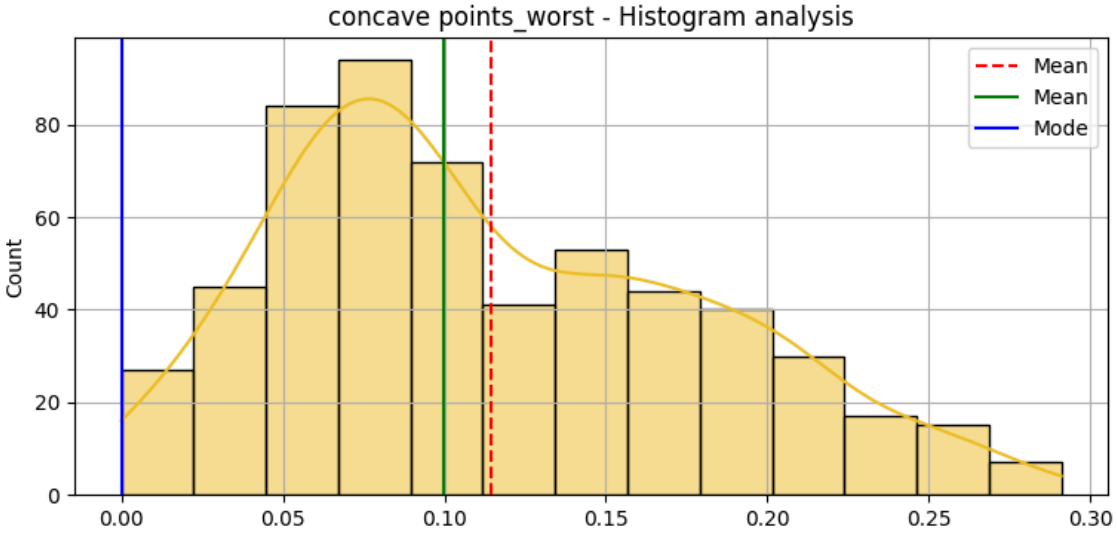

Count
0
20
40
60
80
100
0
500
1000
1500
2000
2500
3000
3500
4000

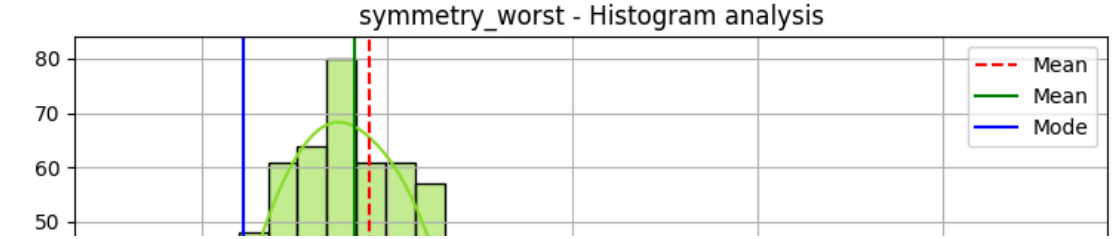

smoothness_worst - Histogram analysis
Mean
Mean
Mode
Count
0
10
20
30
40
50
60
70
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22

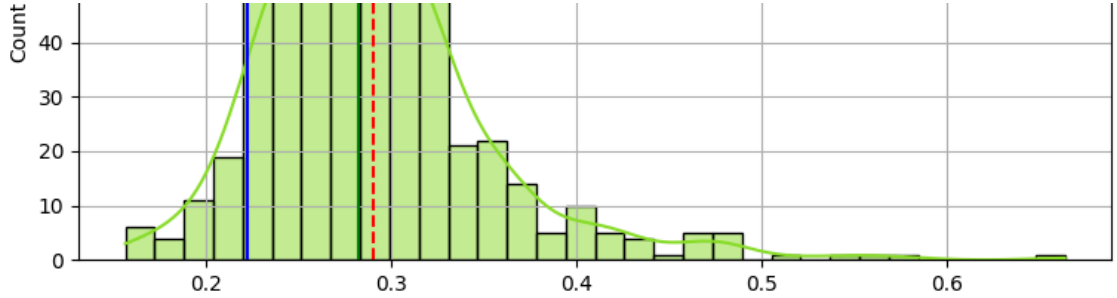

compactness_worst - Histogram analysis
Mean
Mean
Mode
Count
20
40
60
80
100

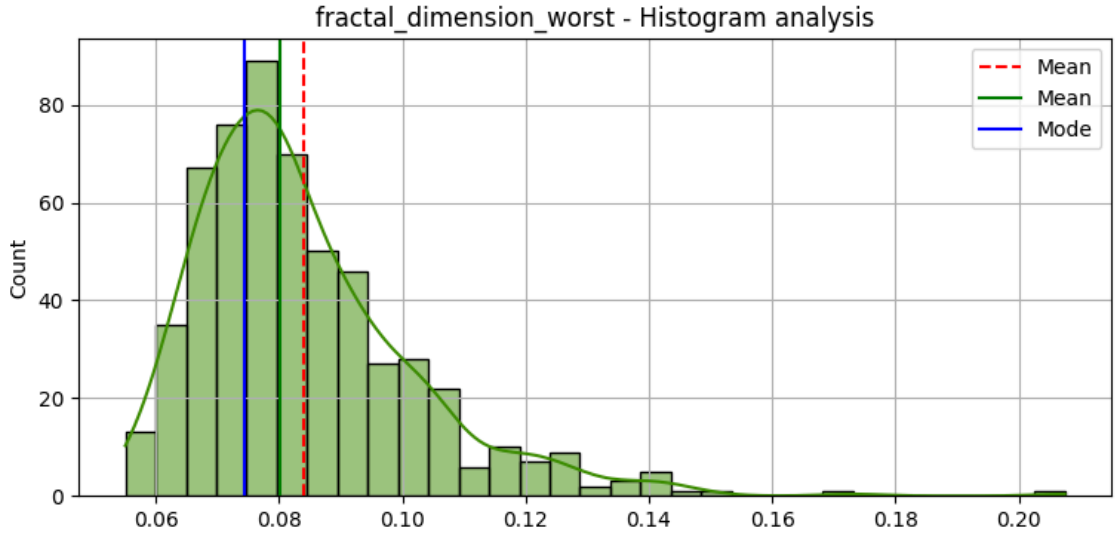

0
0.0
0.2
0.4
0.6
0.8
1.0


concavity_worst - Histogram analysis
Mean
Mean
Mode
Count
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
1.2


concave points_worst - Histogram analysis
Mean
Mean
Mode
Count
0
20
40
60
80
0.00
0.05
0.10
0.15
0.20
0.25
0.30


symmetry_worst - Histogram analysis
Mean
Mean
Mode
50
60
70
80






```
pd.isnull(df).sum() > 0
```

```
radius_mean               False
texture_mean              False
perimeter_mean            False
area_mean                 False
smoothness_mean           False
compactness_mean          False
concavity_mean            False
concave points_mean       False
symmetry_mean             False
fractal_dimension_mean    False
radius_se                 False
texture_se                False
perimeter_se              False
area_se                   False
smoothness_se             False
compactness_se            False
concavity_se              False
concave points_se         False
```

```
symmetry_se               False
fractal_dimension_se      False
radius_worst              False
texture_worst             False
perimeter_worst           False
area_worst                False
smoothness_worst          False
compactness_worst         False
concavity_worst           False
concave points_worst      False
symmetry_worst            False
fractal_dimension_worst   False
diagnosis                 False
dtype: bool
```

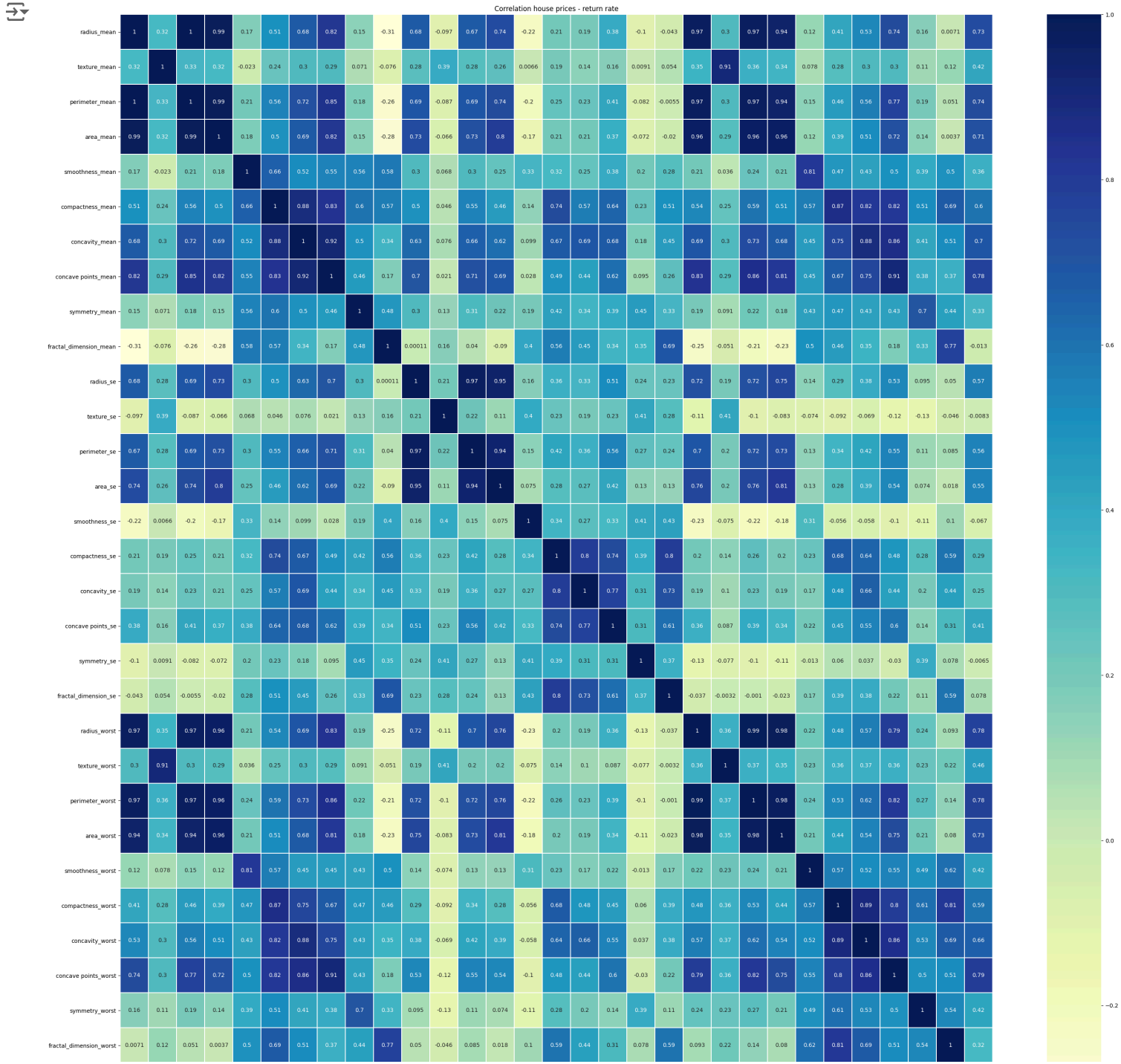
```
df['diagnosis'] = df.diagnosis.astype("category").cat.codes
df.head(10).style.background_gradient(cmap=cm)
```

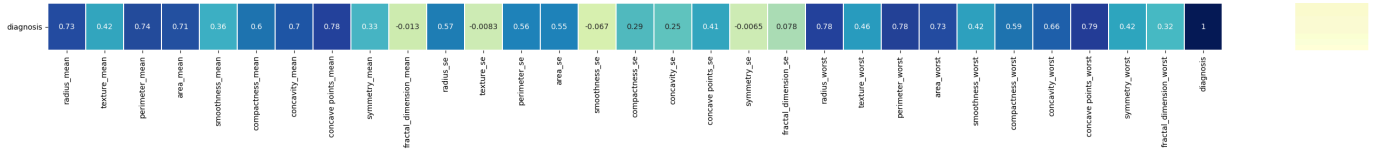
id	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean
842302	17.990000	10.380000	122.800000	1001.000000	0.118400	0.277600	0.300100	0.147100
842517	20.570000	17.770000	132.900000	1326.000000	0.084740	0.078640	0.086900	0.070170
84300903	19.690000	21.250000	130.000000	1203.000000	0.109600	0.159900	0.197400	0.127900
84348301	11.420000	20.380000	77.580000	386.100000	0.142500	0.283900	0.241400	0.105200
84358402	20.290000	14.340000	135.100000	1297.000000	0.100300	0.132800	0.198000	0.104300
843786	12.450000	15.700000	82.570000	477.100000	0.127800	0.170000	0.157800	0.080890
844359	18.250000	19.980000	119.600000	1040.000000	0.094630	0.109000	0.112700	0.074000
84458202	13.710000	20.830000	90.200000	577.900000	0.118900	0.164500	0.093660	0.059850
844981	13.000000	21.820000	87.500000	519.800000	0.127300	0.193200	0.185900	0.093530
84501001	12.460000	24.040000	83.970000	475.900000	0.118600	0.239600	0.227300	0.085430

```
X = df[features]
y = df['diagnosis']
print('Length X:', X.shape)
print('Length Y:', y.shape)
```

```
Length X: (569, 30)
Length Y: (569,)
```

```
def get_headmap(df: dict):
    corr = df.corr()
    plt.figure(figsize=(35, 35))
    sns.heatmap(corr, annot=True, cmap="YlGnBu", linewidths=0.1, annot_kws={"fontsize":10})
    plt.title("Correlation house prices - return rate")

get_headmap(df)
```


Correlation house prices - return rate
radius_mean
texture_mean
perimeter_mean
area_mean
smoothness_mean
compactness_mean
concavity_mean
concave points_mean
symmetry_mean
fractal_dimension_mean
radius_se
texture_se
perimeter_se
area_se
smoothness_se
compactness_se
concavity_se
concave points_se
symmetry_se
fractal_dimension_se
radius_worst
texture_worst
perimeter_worst
area_worst
smoothness_worst
compactness_worst
concavity_worst
concave points_worst
symmetry_worst
fractal_dimension_worst
1.0
0.8
0.6
0.4
0.2
0.0
−0.2



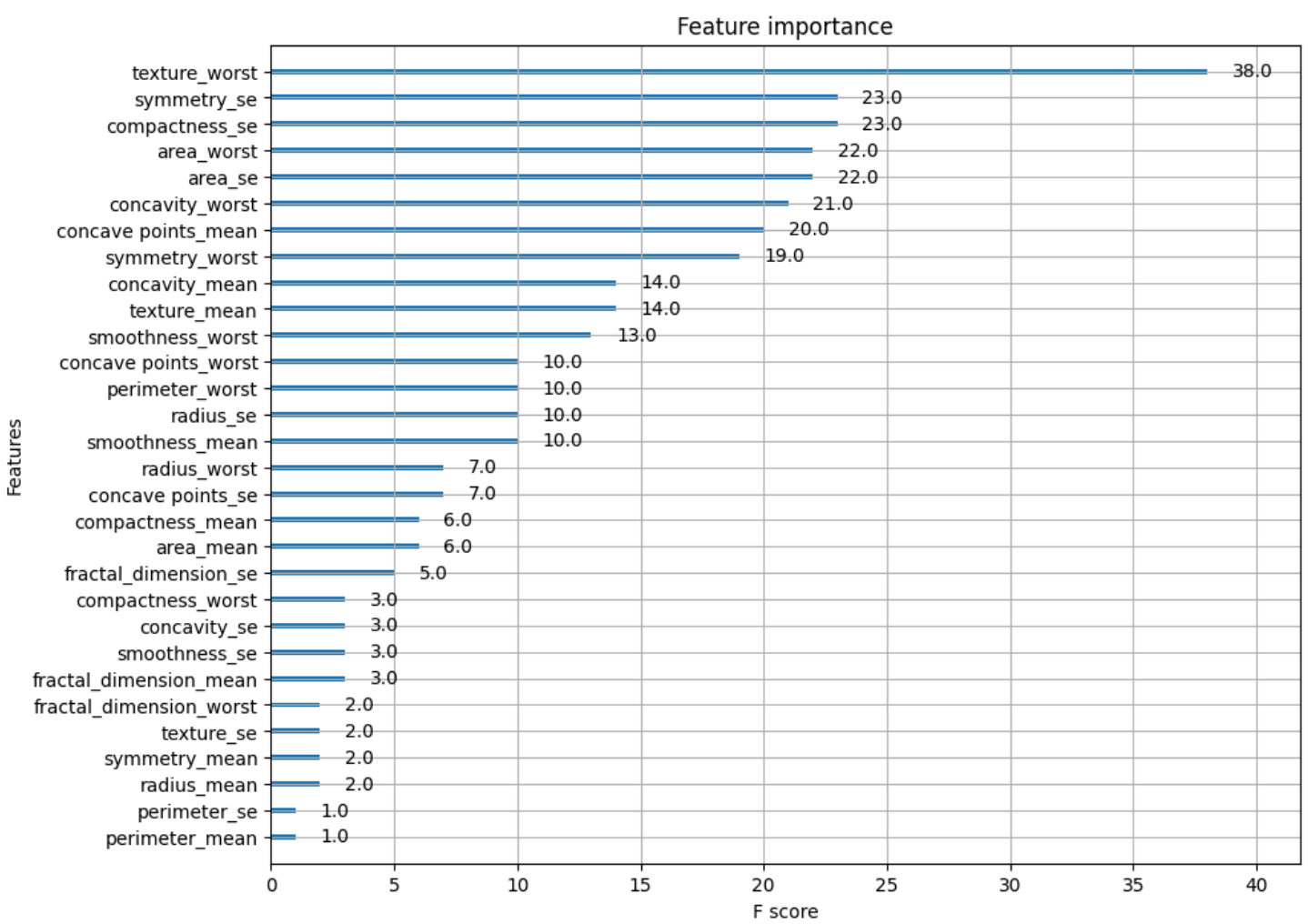

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20)


def KNN(neighbors, X, y):
    model_KNN = KNeighborsClassifier(n_neighbors = 3)
    model_KNN.fit(X , y)

    return model_KNN

np.random.seed(1000)
KNN_predict = KNN(4, X_train, y_train)


from xgboost import plot_importance
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC, LinearSVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import Perceptron
from sklearn.linear_model import SGDClassifier
from sklearn.tree import DecisionTreeClassifier
```

```
from xgboost import XGBClassifier

def machine_learning_algorithms(train_X, train_y):
    estimador = 100

    model_xgb = XGBClassifier(learning_rate=0.3, n_estimators=300, max_depth=14)
    model_xgb.fit(train_X , train_y)

    model_SVC = SVC()
    model_SVC.fit(train_X , train_y)

    model_GBC = GradientBoostingClassifier()
    model_GBC.fit(train_X , train_y)

    model_KNN_v2 = KNeighborsClassifier(n_neighbors = 2)
    model_KNN_v2.fit(train_X , train_y)

    model_KNN_v4 = KNeighborsClassifier(n_neighbors = 4)
    model_KNN_v4.fit(train_X , train_y)

    model_KNN_v6 = KNeighborsClassifier(n_neighbors = 6)
    model_KNN_v6.fit(train_X , train_y)

    model_KNN_v8 = KNeighborsClassifier(n_neighbors = 8)
    model_KNN_v8.fit(train_X , train_y)

    model_LR = LogisticRegression(solver="lbfgs")
    model_LR.fit(train_X , train_y)

    model_RFC = RandomForestClassifier(criterion='gini', max_depth=None, max_features=8, max_leaf_nodes=None,
                                       n_estimators=100)
    model_RFC.fit(train_X , train_y)

    return [model_xgb, model_SVC, model_GBC, model_KNN_v2, model_KNN_v4, model_KNN_v6, model_KNN_v8,
            model_LR, model_RFC]


np.random.seed(1000)
algoritms = machine_learning_algorithms(X_train, y_train)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

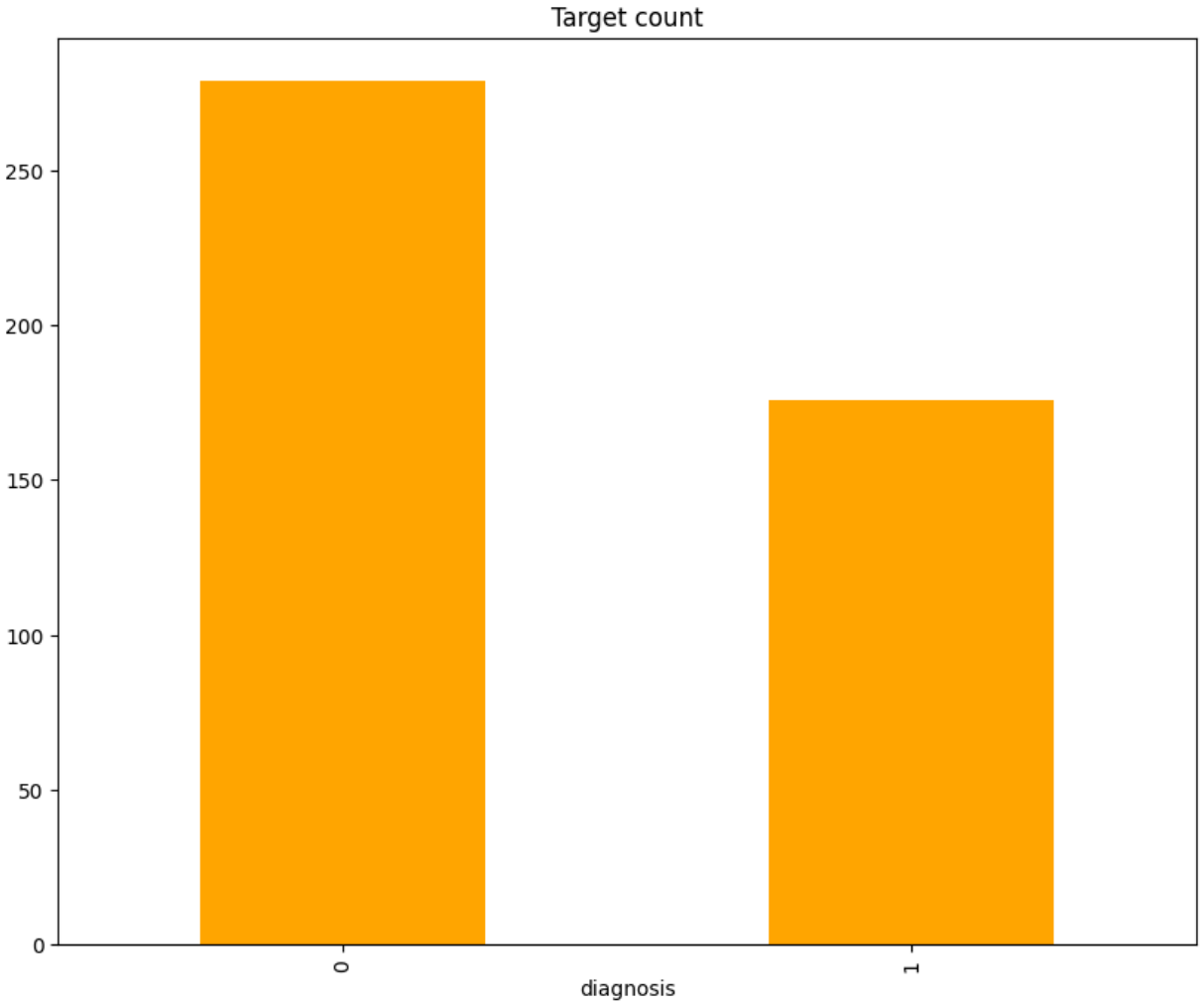
```
score = []
total = []
classifier = ['XGBoost', 'SVG', 'GBC','KNN_v2', 'KNN_v4', 'KNN_v6', 'KNN_v8', 'LR', 'RandomForest']

for index, name in enumerate(classifier):
    score_train = algoritms[index].score(X_train, y_train) * 100
    score_tests = algoritms[index].score(X_test, y_test) * 100
```

```
    total.append([name, score_train, score_tests])

df_result = pd.DataFrame(total, columns = ['Model', 'Train score', 'Test score'])


plt.rcParams["figure.figsize"] = (10, 8)
plot_importance(algoritms [0], max_num_features=100)
plt.show()
```




```
y_train.value_counts().plot(kind='bar', color='orange')
plt.title('Target count')
```

```
Text(0.5, 1.0, 'Target count')
```




```
ax = df_result.plot.bar(x='Model', y='Train score')
ax.set_ylabel("Score")
```

```
Text(0, 0.5, 'Score')
```