1. Fertility Dataset Logistic Regression

e.1 How can I measure the performance of my model?

Accuracy:

Formula: Accuracy = Number of Correct Predictions/Total Number of Prediction

Confusion Matrix:

A confusion matrix is a table with rows and columns representing the actual and predicted classes, respectively. It contains four terms: True Positive (TP): Correctly predicted positive instances. True Negative (TN): Correctly predicted negative instances. False Positive (FP): Incorrectly predicted positive instances (Type I error). False Negative (FN): Incorrectly predicted negative instances (Type II error).

Precision:

Formula: Precision = TP/TP+FP

Recall (also known as Sensitivity or True Positive Rate): Formula: Recall= TP/TP+FN

F1 Score:

Formula: F1 Score=2× Precision*Recall/Precision+Recall

ROC Curve:

Plot the True Positive Rate (TPR) against the False Positive Rate (FPR) at various threshold settings. TPR (Recall) = TP/TP+FN FPR = FP/FP+TN

Area Under the ROC Curve (AUC):

The area under the ROC curve provides an aggregate measure of performance across all possible classification thresholds. A perfect classifier has an AUC of 1, while a purely random classifier has an AUC of 0.5.

Log Loss (Logarithmic Loss): Quantifies the accuracy of a probabilistic model. Measures the difference between predicted probabilities and actual outcomes.

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

# Load the dataset
file_path = 'fertility_Diagnosis.txt'
columns = ['Season', 'Age', 'Childhood Diseases',
            'Accident or Serious Trauma','Surgical Intervention',
            'High Fevers in Last Year',
            'Frequency of Alcohol Consumption','Smoking Habit',
            'Number of Hours Spent Sitting Per Day', 'Diagnosis']
dataset = pd.read_csv(file_path, header=None, names=columns)
# Display the first few rows of the dataset to understand its structure
dataset.head()
```

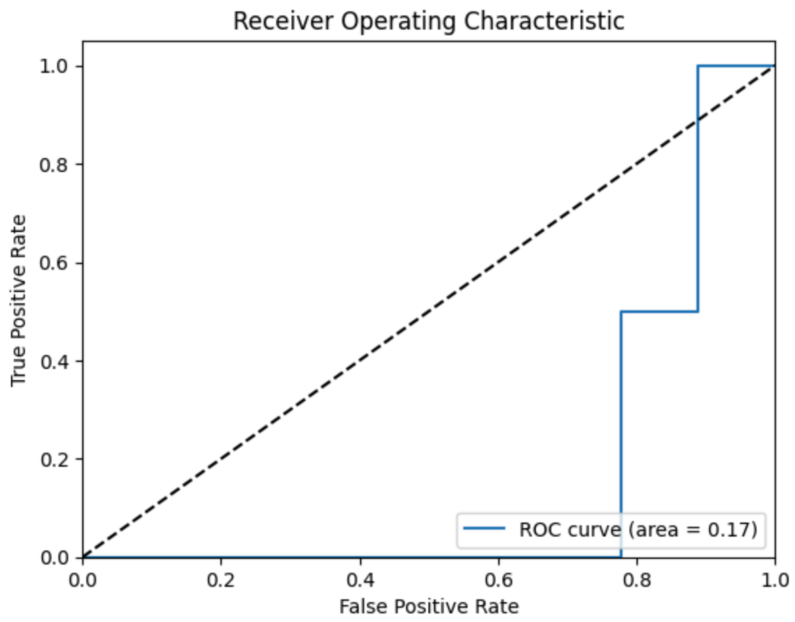
	Season	Age	Childhood Diseases	Accident or Serious Trauma	Surgical Intervention	High Fevers in Last Year	Frequency of Alcohol Consumption	Smoking Habit	Number of Hours Spent Sitting Per Day	Diagnosis
0	-0.33	0.69	0	1	1	0	0.8	0	0.88	N
1	-0.33	0.94	1	0	1	0	0.8	1	0.31	O
2	-0.33	0.50	1	0	0	0	1.0	-1	0.50	N
3	-0.33	0.75	0	1	1	0	1.0	-1	0.38	N

Next steps: Generate code with `dataset` View recommended plots

```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
# Encode the 'Diagnosis' column to numerical format
label_encoder = LabelEncoder()
dataset['Diagnosis'] = label_encoder.fit_transform(dataset['Diagnosis'])
# Split the dataset into features and target variable
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, -1].values
# Split the dataset into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=42)
# Verify the shapes of the splits
(X_train.shape, X_test.shape, y_train.shape, y_test.shape)
```

```
((80, 9), (20, 9), (80,), (20,))
```

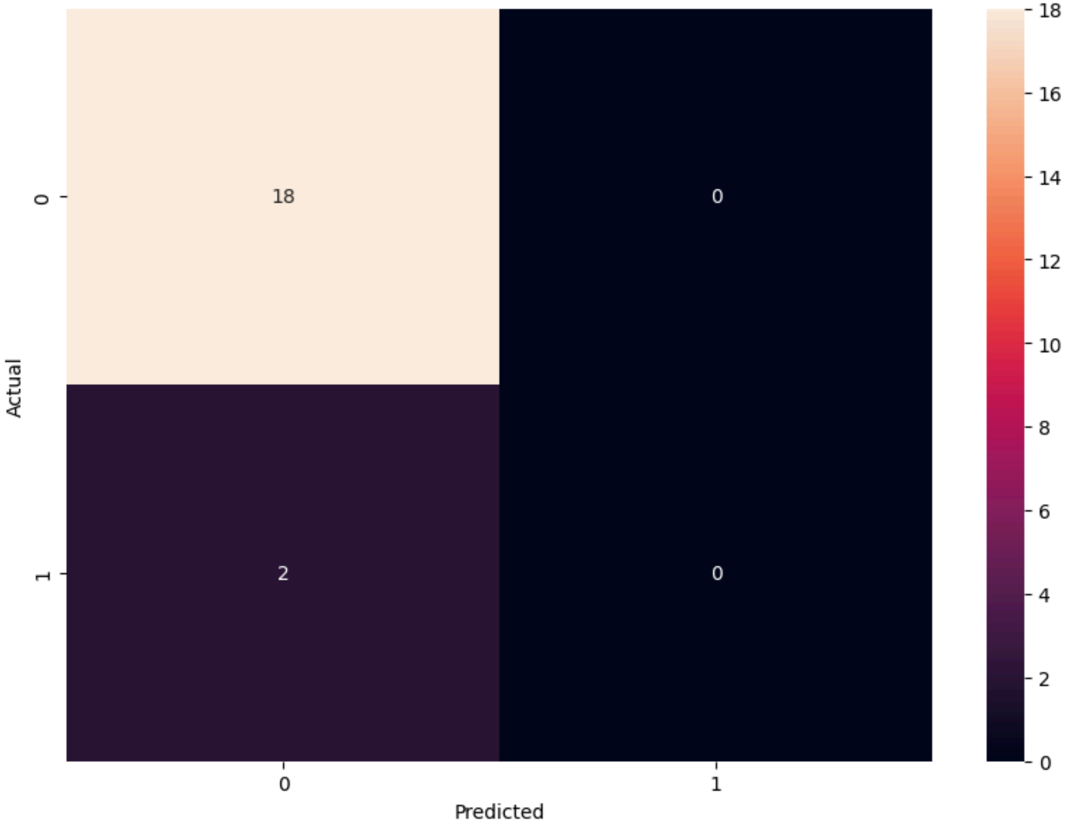
```
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,recall_score, f1_score
from sklearn.metrics import roc_auc_score, roc_curve, log_loss
import numpy as np
import matplotlib.pyplot as plt
# Initialize and train the logistic regression model
log_reg = LogisticRegression(max_iter=1000, random_state=42)
log_reg.fit(X_train, y_train)
# Predicting the Test set results
y_pred = log_reg.predict(X_test)
y_pred_proba = log_reg.predict_proba(X_test)[:, 1]
# Calculate the evaluation metrics
metrics = {
'Accuracy': accuracy_score(y_test, y_pred),
'Confusion Matrix': confusion_matrix(y_test, y_pred),
'Precision': precision_score(y_test, y_pred, zero_division=0),
'Recall': recall_score(y_test, y_pred),
'F1 Score': f1_score(y_test, y_pred),
'ROC AUC': roc_auc_score(y_test, y_pred_proba),
'Log Loss': log_loss(y_test, y_pred_proba)
}
# ROC Curve
fpr, tpr, thresholds = roc_curve(y_test, y_pred_proba)
# Plotting ROC Curve
plt.figure()
plt.plot(fpr, tpr, label='ROC curve (area = %0.2f)' % metrics['ROC AUC'])
plt.plot([0, 1], [0, 1], 'k--')
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic')
plt.legend(loc="lower right")
plt.show()
metrics
```




```
{'Accuracy': 0.9,
 'Confusion Matrix': array([[18,  0],
        [ 2,  0]]),
 'Precision': 0.0,
 'Recall': 0.0,
 'F1 Score': 0.0,
 'ROC AUC': 0.16666666666666669,
 'Log Loss': 0.4650481752720365}
```

```
# plot the confusion matrix
plt.figure(figsize=(10,7))
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d')
plt.xlabel('Predicted')
plt.ylabel('Actual')
```

```
Text(95.72222222222221, 0.5, 'Actual')
```



2. Naive_Bayesian Breast Cancer

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,recall_score, f1_score
```

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,recall_score, f1_score
# Load the new dataset for Breast Cancer Data
data_path ='BreastCancerData.csv'
breast_cancer_data = pd.read_csv(data_path)
# Display the first few rows of the dataset to understand its structure
breast_cancer_data.head()
```

	mean_radius	mean_texture	mean_perimeter	mean_area	mean_smoothness	diagnosis
0	17.99	10.38	122.80	1001.0	0.11840	0
1	20.57	17.77	132.90	1326.0	0.08474	0
2	19.69	21.25	130.00	1203.0	0.10960	0
3	11.42	20.38	77.58	386.1	0.14250	0
4	20.29	14.34	135.10	1297.0	0.10030	0

Next steps: Generate code with breast_cancer_data View recommended plots

```
# Split the dataset into features (X) and the target variable (y)
X = breast_cancer_data.drop('diagnosis', axis=1).values
y = breast_cancer_data['diagnosis'].values
# Split the dataset into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=42)
# Initialize and train the Naive Bayes classifier
nb_classifier = GaussianNB()
nb_classifier.fit(X_train, y_train)
# Predicting the Test set results
y_pred = nb_classifier.predict(X_test)
# Calculate evaluation metrics
accuracy = accuracy_score(y_test, y_pred)
confusion_mat = confusion_matrix(y_test, y_pred)
precision = precision_score(y_test, y_pred, zero_division=0)
recall = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
# Print the evaluation metrics
print(f'Accuracy: {accuracy}')
print(f'Confusion Matrix: \n{confusion_mat}')
print(f'Precision: {precision}')
print(f'Recall: {recall}')
print(f'F1 Score: {f1}')
```

```
Accuracy: 0.9385964912280702
Confusion Matrix:
[[36  7]
 [ 0 71]]
Precision: 0.9102564102564102
Recall: 1.0
F1 Score: 0.953020134228188
```

```
# plot the confusion matrix
plt.figure(figsize=(10,7))
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d')
plt.xlabel('Predicted')
plt.ylabel('Actual')
```