```
# Chaitanya Mangla AI - DS B1
# Car insurance Claim Prediction
# Predict whether a customer will make an insurancce claimmnext year 9 feature: Age, car age, annual premium, region, previous claimset
```

[136] ✓ 0.0s Python

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

[137] ✓ 0.0s Python

```
# Making the Synthetic dataset
np.random.seed(42)
n = 5000
data = pd.DataFrame({
    'Age': np.random.randint(18, 70, n),
    'Gender': np.random.choice(['Male', 'Female'], n),
    'Vehicle_Age': np.random.randint(1, 15, n),
    'Vehicle_Type': np.random.choice(['Sedan', 'SUV', 'Truck'], n),
    'Annual_Premium': np.random.randint(20000, 80000, n),
    'Region_Code': np.random.randint(1, 50, n),
    'Driving_Experience': np.random.randint(1, 30, n),
    'Previous_Claims': np.random.randint(0, 5, n),
    'Policy_Tenure': np.random.randint(1, 10, n)
})
data
# The whole data is printed in tabular form
```

[138] ✓ 0.0s

| | Age | Gender | Vehicle_Age | Vehicle_Type | Annual_Premium | Region_Code | Driving_Experience | Previous_Claims | Policy_Tenure |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 56 | Male | 6 | Sedan | 73974 | 44 | 22 | 3 | 9 |
| 1 | 69 | Female | 5 | Truck | 36925 | 48 | 12 | 0 | 7 |
| 2 | 46 | Female | 1 | Sedan | 26033 | 23 | 17 | 4 | 7 |
| 3 | 32 | Male | 6 | Truck | 22665 | 6 | 24 | 2 | 7 |
| 4 | 60 | Male | 1 | Sedan | 47025 | 24 | 14 | 3 | 2 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 4995 | 24 | Male | 9 | Truck | 27944 | 14 | 19 | 2 | 8 |
| 4996 | 66 | Female | 10 | SUV | 68702 | 10 | 12 | 0 | 2 |
| 4997 | 26 | Female | 3 | Truck | 32747 | 45 | 23 | 3 | 1 |
| 4998 | 53 | Female | 8 | SUV | 30505 | 33 | 29 | 4 | 4 |
| 4999 | 36 | Female | 1 | Truck | 66217 | 42 | 27 | 2 | 9 |

5000 rows × 9 columns

```
# Simulated Trget = Probability of claim increases with the previous claims, vehicles, age etc
data['Claim'] = (data['Previous_Claims']*0.2 + (data['Vehicle_Age'] / 15 * 0.3) +
    (np.random.rand(n) * 0.2)
)
data['Claim'] = (data['Claim'] > 0.35).astype(int)
```

[139]
```
data.head()
```

| | Age | Gender | Vehicle_Age | Vehicle_Type | Annual_Premium | Region_Code | Driving_Experience | Previous_Claims | Policy_Tenure | Claim |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 56 | Male | 6 | Sedan | 73974 | 44 | 22 | 3 | 9 | 1 |
| 1 | 69 | Female | 5 | Truck | 36925 | 48 | 12 | 0 | 7 | 0 |
| 2 | 46 | Female | 1 | Sedan | 26033 | 23 | 17 | 4 | 7 | 1 |
| 3 | 32 | Male | 6 | Truck | 22665 | 6 | 24 | 2 | 7 | 1 |
| 4 | 60 | Male | 1 | Sedan | 47025 | 24 | 14 | 3 | 2 | 1 |

```
# Encoding the categorical variabes
data = pd.get_dummies(data, columns=['Gender', 'Vehicle_Type'], drop_first=True)
data
# The categorical data gets converted to Numerical type
```

140] ✓ 0.0s Python

| | Age | Vehicle_Age | Annual_Premium | Region_Code | Driving_Experience | Previous_Claims | Policy_Tenure | Claim | Gender_Male | Vehicle_Type_Sedan |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 56 | 6 | 73974 | 44 | 22 | 3 | 9 | 1 | True | True |
| 1 | 69 | 5 | 36925 | 48 | 12 | 0 | 7 | 0 | False | False |
| 2 | 46 | 1 | 26033 | 23 | 17 | 4 | 7 | 1 | False | True |
| 3 | 32 | 6 | 22665 | 6 | 24 | 2 | 7 | 1 | True | False |
| 4 | 60 | 1 | 47025 | 24 | 14 | 3 | 2 | 1 | True | True |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 4995 | 24 | 9 | 27944 | 14 | 19 | 2 | 8 | 1 | True | False |
| 4996 | 66 | 10 | 68702 | 10 | 12 | 0 | 2 | 1 | False | False |
| 4997 | 26 | 3 | 32747 | 45 | 23 | 3 | 1 | 1 | False | False |
| 4998 | 53 | 8 | 30505 | 33 | 29 | 4 | 4 | 1 | False | False |

```
X # X dataset is being printed here
```

[142] ✓ 0.0s Python

| | Age | Vehicle_Age | Annual_Premium | Region_Code | Driving_Experience | Previous_Claims | Policy_Tenure | Gender_Male | Vehicle_Type_Sedan | Vehi |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 56 | 6 | 73974 | 44 | 22 | 3 | 9 | True | True | |
| 1 | 69 | 5 | 36925 | 48 | 12 | 0 | 7 | False | False | |
| 2 | 46 | 1 | 26033 | 23 | 17 | 4 | 7 | False | True | |
| 3 | 32 | 6 | 22665 | 6 | 24 | 2 | 7 | True | False | |
| 4 | 60 | 1 | 47025 | 24 | 14 | 3 | 2 | True | True | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| 4995 | 24 | 9 | 27944 | 14 | 19 | 2 | 8 | True | False | |
| 4996 | 66 | 10 | 68702 | 10 | 12 | 0 | 2 | False | False | |
| 4997 | 26 | 3 | 32747 | 45 | 23 | 3 | 1 | False | False | |
| 4998 | 53 | 8 | 30505 | 33 | 29 | 4 | 4 | False | False | |
| 4999 | 36 | 1 | 66217 | 42 | 27 | 2 | 9 | False | False | |

5000 rows × 10 columns

```
y  # The data y is being prited here
```

[143] ✓ 0.0s

```
0       1
1       0
2       1
3       1
4       1
       ..
4995    1
4996    1
4997    1
4998    1
4999    1
Name: Claim, Length: 5000, dtype: int64
```

```
# Trian test and split
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.2, random_state=42, stratify=y
)
```

[144] ✓ 0.0s

```
X_train # Data on which the model is trained
```

[145] ✓ 0.0s Python

| | Age | Vehicle_Age | Annual_Premium | Region_Code | Driving_Experience | Previous_Claims | Policy_Tenure | Gender_Male | Vehicle_Type_Sedan | Vehi |
|---|---|---|---|---|---|---|---|---|---|---|
| 2502 | 38 | 12 | 61800 | 38 | 26 | 3 | 3 | False | False | |
| 4448 | 21 | 13 | 37221 | 21 | 24 | 2 | 6 | False | True | |
| 1782 | 51 | 9 | 28117 | 5 | 12 | 0 | 2 | True | True | |
| 3194 | 68 | 13 | 53427 | 10 | 26 | 1 | 3 | True | False | |
| 2884 | 28 | 10 | 78334 | 1 | 9 | 4 | 3 | False | False | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| 2681 | 20 | 3 | 78609 | 34 | 28 | 4 | 7 | True | False | |
| 3866 | 24 | 5 | 55939 | 12 | 12 | 0 | 5 | False | False | |
| 4222 | 28 | 2 | 39861 | 38 | 29 | 3 | 6 | False | False | |
| 1478 | 34 | 4 | 76088 | 12 | 16 | 2 | 7 | True | True | |
| 793 | 23 | 13 | 44668 | 49 | 22 | 2 | 7 | False | False | |

4000 rows × 10 columns

```
X_test # Data on which the model is tested
```

[146] ✓ 0.0s Python

| | Age | Vehicle_Age | Annual_Premium | Region_Code | Driving_Experience | Previous_Claims | Policy_Tenure | Gender_Male | Vehicle_Type_Sedan | Vehi |
|---|---|---|---|---|---|---|---|---|---|---|
| 3402 | 23 | 4 | 61604 | 34 | 21 | 3 | 9 | False | False | |
| 1601 | 36 | 3 | 23089 | 17 | 7 | 3 | 6 | False | False | |
| 3348 | 39 | 2 | 31848 | 5 | 20 | 2 | 2 | False | True | |
| 3792 | 46 | 13 | 77558 | 34 | 25 | 2 | 2 | True | True | |
| 1071 | 21 | 11 | 63950 | 16 | 28 | 0 | 5 | True | True | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| 4907 | 58 | 13 | 45280 | 5 | 16 | 0 | 1 | True | False | |
| 1710 | 62 | 6 | 32631 | 3 | 18 | 0 | 2 | False | False | |
| 3732 | 58 | 11 | 76679 | 20 | 14 | 2 | 7 | False | True | |
| 639 | 58 | 9 | 78755 | 37 | 13 | 2 | 9 | True | False | |
| 3880 | 64 | 10 | 20589 | 48 | 12 | 2 | 2 | True | False | |

1000 rows × 10 columns

```
y_train # Data on which the model is trained
```

[147] ✓ 0.0s

```
2502    1
4448    1
1782    0
3194    1
2884    1
       ..
2681    1
3866    0
4222    1
1478    1
793     1
Name: Claim, Length: 4000, dtype: int64
```

```
y_test  # Data on which the model is tested
```

[148] ✓ 0.0s

```
3402    1
1601    1
3348    1
3792    1
1071    0
       ..
4907    1
1710    0
3732    1
639     1
3880    1
Name: Claim, Length: 1000, dtype: int64
```

```python
# Scaling the features
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

[149] ✓ 0.0s

```python
X_train_scaled
```

[150] ✓ 0.0s

```
array([[-0.37745591,  1.10033821,  0.68185175, ..., -1.00551521,
        -0.70300067, -0.71055675],
       [-1.51563167,  1.34824589, -0.73629409, ..., -1.00551521,
         1.42247376, -0.71055675],
       [ 0.49291379,  0.35661519, -1.26157176, ...,  0.99451504,
         1.42247376, -0.71055675],
       ...,
       [-1.04697106, -1.37873853, -0.5839728 , ..., -1.00551521,
        -0.70300067,  1.40734713],
       [-0.64526197, -0.88292318,  1.50623304, ...,  0.99451504,
         1.42247376, -0.71055675],
       [-1.38172863,  1.34824589, -0.30662112, ..., -1.00551521,
        -0.70300067, -0.71055675]], shape=(4000, 10))
```

```
X_test_scaled
```

[151] ✓ 0.0s

```
array([[-1.38172863, -0.88292318,  0.67054305, ..., -1.00551521,
        -0.70300067, -0.71055675],
       [-0.51135894, -1.13083086, -1.55167458, ..., -1.00551521,
        -0.70300067,  1.40734713],
       [-0.31050439, -1.37873853, -1.04630254, ..., -1.00551521,
         1.42247376, -0.71055675],
       ...,
       [ 0.9615744 ,  0.85243054,  1.54033224, ..., -1.00551521,
         1.42247376, -0.71055675],
       [ 0.9615744 ,  0.35661519,  1.66011217, ...,  0.99451504,
        -0.70300067,  1.40734713],
       [ 1.36328349,  0.60452286, -1.69591823, ...,  0.99451504,
        -0.70300067, -0.71055675]], shape=(1000, 10))
```

```python
from xgboost import XGBClassifier
model = XGBClassifier(
    n_estimators=200,
    learning_rate=0.1,
    max_depth=5,
    random_state=42,
    eval_metric='logloss'
)
model.fit(X_train, y_train)
```

XGBClassifier

▼ Parameters

| | |
|---|---|
| objective | 'binary:logistic' |
| base_score | None |
| booster | None |
| callbacks | None |
| colsample_bylevel | None |
| colsample_bynode | None |
| colsample_bytree | None |
| device | None |
| early_stopping_rounds | None |
| enable_categorical | False |
| eval_metric | 'logloss' |
| feature_types | None |
| feature_weights | None |
| gamma | None |
| grow_policy | None |
| importance_type | None |
| interaction_constraints | None |
| learning_rate | 0.1 |
| max_bin | None |
| max_cat_threshold | None |
| max_cat_to_onehot | None |
| max_delta_step | None |
| max_depth | 5 |

```
from sklearn.metrics import accuracy_score, classification_report, roc_auc_score, confusion_matrix
```

[156] ✓ 0.0s

```
print("Accuracy:" , accuracy_score(y_test, y_pred))
```

[157] ✓ 0.0s

```
Accuracy: 0.421
```

```
print("Classification Report\n", classification_report(y_test, y_pred))
```

[158] ✓ 0.0s

```
Classification Report
              precision    recall  f1-score   support

           0       0.26      1.00      0.41       200
           1       1.00      0.28      0.43       800

    accuracy                           0.42      1000
   macro avg       0.63      0.64      0.42      1000
weighted avg       0.85      0.42      0.43      1000
```

```
print("ROC AUC Score\n", roc_auc_score(y_test, y_prob))
```

[159] ✓ 0.0s

```
ROC AUC Score
 0.6541124999999999
```

```
print("Confusion matrix\n", confusion_matrix(y_test, y_pred))
```

[160] ✓ 0.0s

```
Confusion matrix
 [[200   0]
 [579 221]]
```

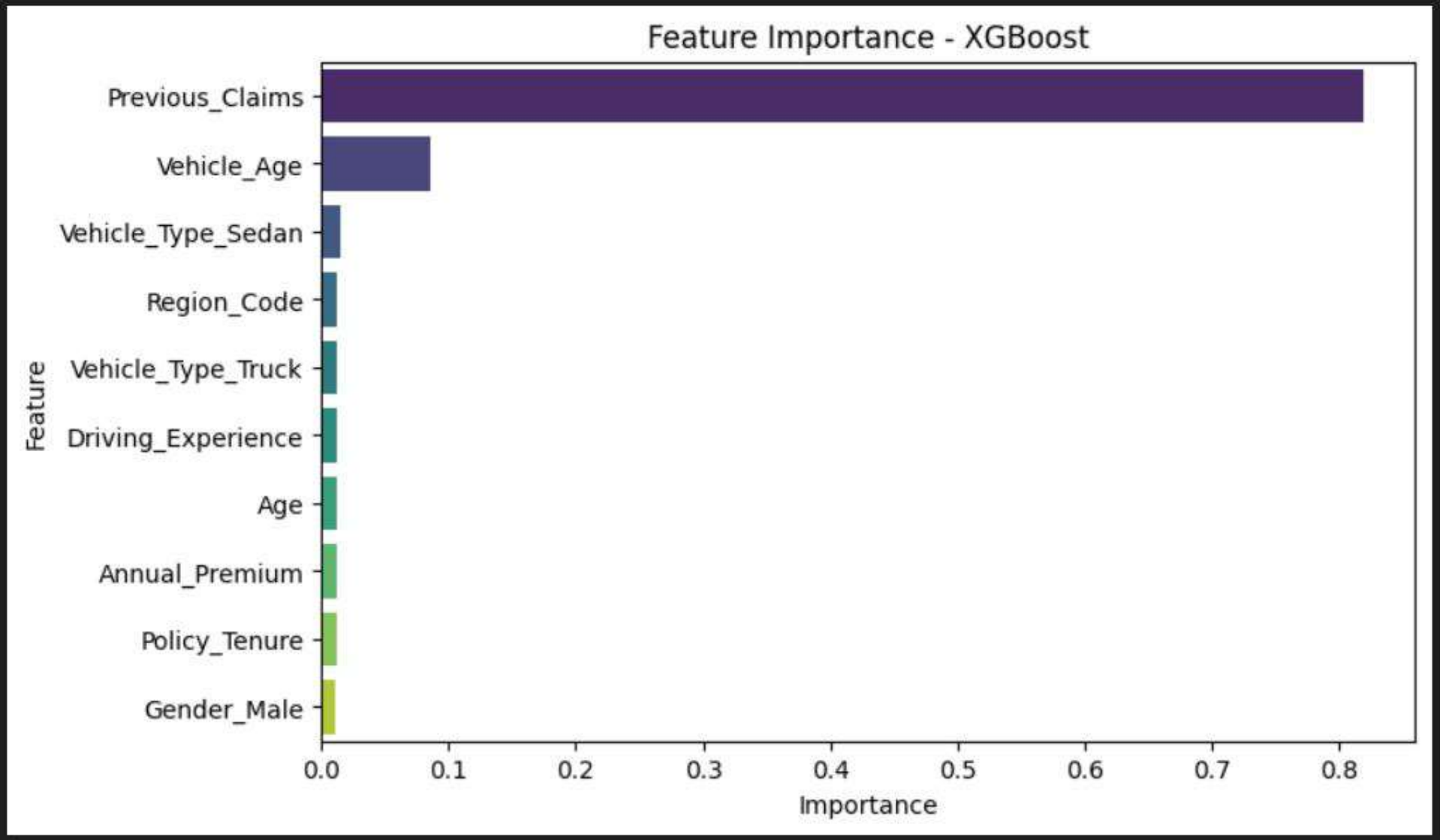
```
# Feature Importance
importance = pd.DataFrame({
    'Feature': X.columns,
    'Importance': model.feature_importances_
}).sort_values(by='Importance', ascending=False)

print("\n🔍 Feature Importance:")
print(importance)

plt.figure(figsize=(8, 5))
sns.barplot(data=importance, x='Importance', y='Feature', palette='viridis')
plt.title("Feature Importance - XGBoost")
plt.show()
```

[161] ✓ 0.1s

```
sns.barplot(data=importance, x='Importance', y='Feature', palette='viridis')
```



```
# New data with same columns as training set
new_customers = pd.DataFrame({
    'Age': [28, 45, 36, 62, 50],
    'Gender': ['Female', 'Male', 'Male', 'Female', 'Male'],
    'Vehicle_Age': [2, 8, 5, 12, 4],
    'Vehicle_Type': ['Sedan', 'SUV', 'Truck', 'SUV', 'Sedan'],
    'Annual_Premium': [35000, 62000, 47000, 55000, 40000],
    'Region_Code': [14, 27, 35, 9, 22],
    'Driving_Experience': [4, 20, 10, 35, 15],
    'Previous_Claims': [0, 1, 2, 3, 0],
    'Policy_Tenure': [2, 6, 4, 9, 5]
})

print(new_customers)

# Encode categorical features using same encoders from training

new_customers = pd.get_dummies(new_customers, columns=['Gender', 'Vehicle_Type'], drop_first=True)

# Ensure same column order as training
new_customers = new_customers[X.columns]

# Scale features using the same scaler
new_customers_scaled = scaler.fit_transform(new_customers)

# Predict class and probability
preds = model.predict(new_customers_scaled)
probs = model.predict_proba(new_customers_scaled)[:, 1]

# Add predictions to the DataFrame
new_customers['Predicted_Claim'] = preds
new_customers['Claim_Probability'] = probs

[170]
print("\n Prediction Results:")
```

```
...      Age  Gender  Vehicle_Age Vehicle_Type  Annual_Premium  Region_Code  \
    0    28  Female            2        Sedan           35000           14
    1    45    Male            8          SUV           62000           27
    2    36    Male            5        Truck           47000           35
    3    62  Female           12          SUV           55000            9
    4    50    Male            4        Sedan           40000           22

       Driving_Experience  Previous_Claims  Policy_Tenure
    0                   4                0              2
    1                  20                1              6
    2                  10                2              4
    3                  35                3              9
    4                  15                0              5

     Prediction Results:
       Age  Vehicle_Age  Annual_Premium  Region_Code  Driving_Experience  \
    0   28            2           35000           14                   4
    1   45            8           62000           27                  20
    2   36            5           47000           35                  10
    3   62           12           55000            9                  35
    4   50            4           40000           22                  15

       Previous_Claims  Policy_Tenure  Gender_Male  Vehicle_Type_Sedan  \
    0                0              2        False                True
    1                1              6         True               False
    ...
    1             False                0          0.010046
    2              True                0          0.007888
    3             False                1          0.946591
    4             False                0          0.012659
```

*Output is truncated. View as a scrollable element or open in a text editor. Adjust cell output settings...*