Data Glacier

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Project : Persistency of a drug

Domain : Healthcare

Specialization : Data Science

University: Osmania University

Batch: LISUM12

Submitted by : Amima Shifa

Agenda

Problem Statement

Data Intake

Data Summary

EDA

Models Development and Selection

Evaluation of Models

Conclusion

Problem Statement

One of the challenges for Pharmaceutical companies is to understand the persistency of drug as per the physician prescription. However, the team of data scientist is capable of discovering the analyzing the dataset and detecting the factors that are impacting the primary factor which is the "persistency". By building a classification machine learning model, to automate this process of identification.

Objective:

To gather insights on the factors that are impacting the persistency, build a classification for the given dataset.

Target Variable:

Persistency_Flag

Data Intake

Data Intake Report

Name: Healthcare – Data Science

Report date: 24th September 2022

Internship Batch: LISUM12

Version: 1.0

Data intake by: Amima Shifa

Data intake reviewer: Data Glacier

Dataset storage location:

https://github.com/AmimaShifa/WEEKLY-TASKS/blob/main/Week-7/dataset.csv

Tabular data details:

Total number of observations	3424
Total number of files	1
Total number of features	26
Base format of the file	.xlsx
Size of the data	898 KB

Data Summary

- 70 Features
- 3424 Observations
- Size of data : 898 kb

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3424 entries, 0 to 3423
Data columns (total 70 columns):
 #   Column                                                                  Non-Null Count  Dtype
---  ------                                                                  --------------  -----
 0   Unnamed: 0                                                              3424 non-null   int64
 1   Ptid                                                                    3424 non-null   object
 2   Persistency_Flag                                                        3424 non-null   object
 3   Gender                                                                  3424 non-null   object
 4   Race                                                                    3424 non-null   object
 5   Ethnicity                                                               3424 non-null   object
 6   Region                                                                  3424 non-null   object
 7   Age_Bucket                                                              3424 non-null   object
 8   Ntm_Speciality                                                          3424 non-null   object
 9   Ntm_Specialist_Flag                                                     3424 non-null   object
 10  Ntm_Speciality_Bucket                                                   3424 non-null   object
 11  Gluco_Record_Prior_Ntm                                                  3424 non-null   object
 12  Gluco_Record_During_Rx                                                  3424 non-null   object
 13  Dexa_Freq_During_Rx                                                     3424 non-null   int64
 14  Dexa_During_Rx                                                          3424 non-null   object
 15  Frag_Frac_Prior_Ntm                                                     3424 non-null   object
 16  Frag_Frac_During_Rx                                                     3424 non-null   object
 17  Risk_Segment_Prior_Ntm                                                  3424 non-null   object
 18  Tscore_Bucket_Prior_Ntm                                                 3424 non-null   object
 19  Risk_Segment_During_Rx                                                  3424 non-null   object
 20  Tscore_Bucket_During_Rx                                                 3424 non-null   object
 21  Change_T_Score                                                          3424 non-null   object
```

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Data types

```
df.dtypes
```

```
Unnamed: 0                             int64
Ptid                                  object
Persistency_Flag                      object
Gender                                object
Race                                  object
                                       ...
Risk_Hysterectomy_Oophorectomy        object
Risk_Estrogen_Deficiency              object
Risk_Immobilization                   object
Risk_Recurring_Falls                  object
Count_Of_Risks                         int64
Length: 70, dtype: object
```

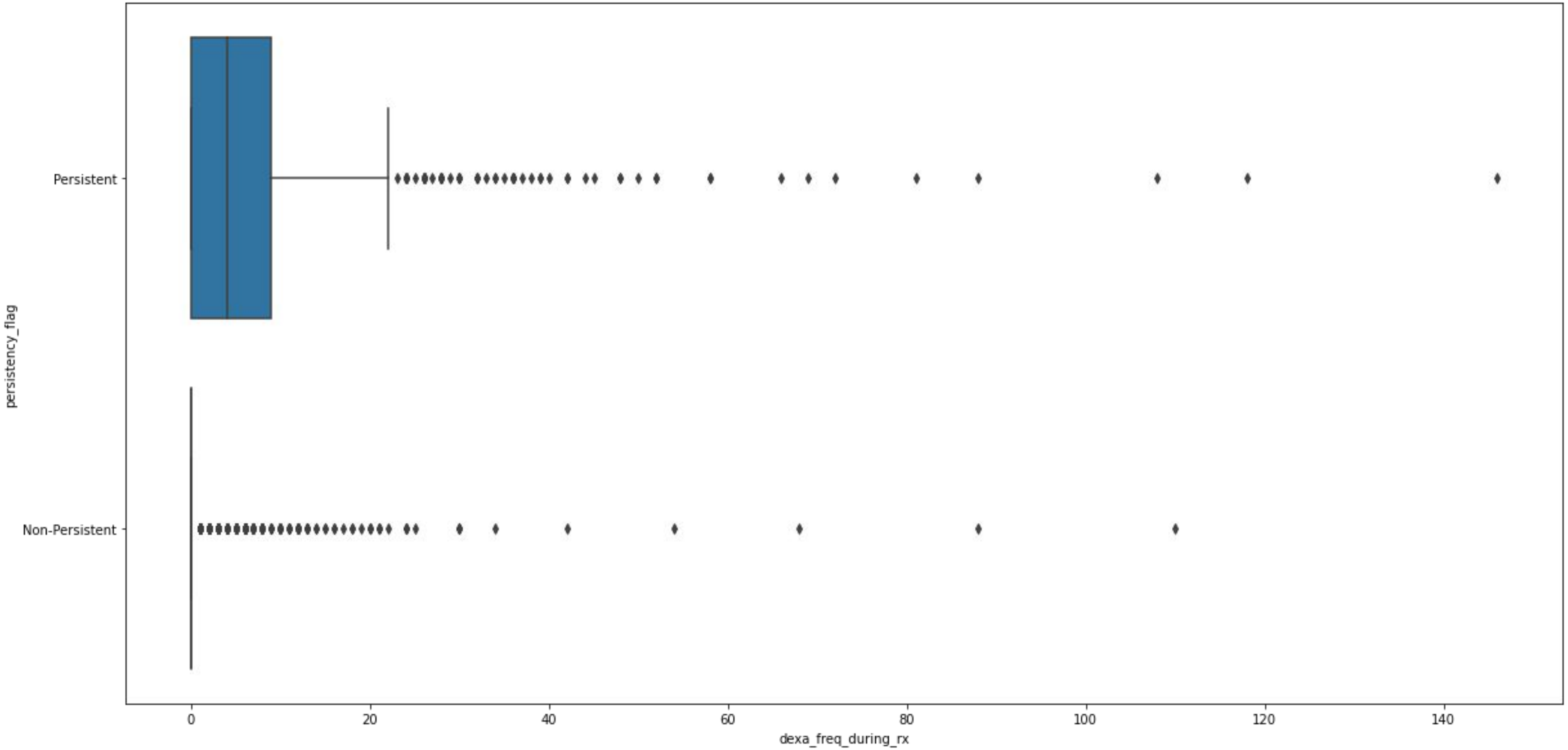
Missing Values

```
df.isnull().sum()
```

```
unnamed: 0                          0
ptid                                0
persistency_flag                    0
gender                              0
race                                0
                                   ..
risk_hysterectomy_oophorectomy      0
risk_estrogen_deficiency            0
risk_immobilization                 0
risk_recurring_falls                0
count_of_risks                      0
Length: 70, dtype: int64
```

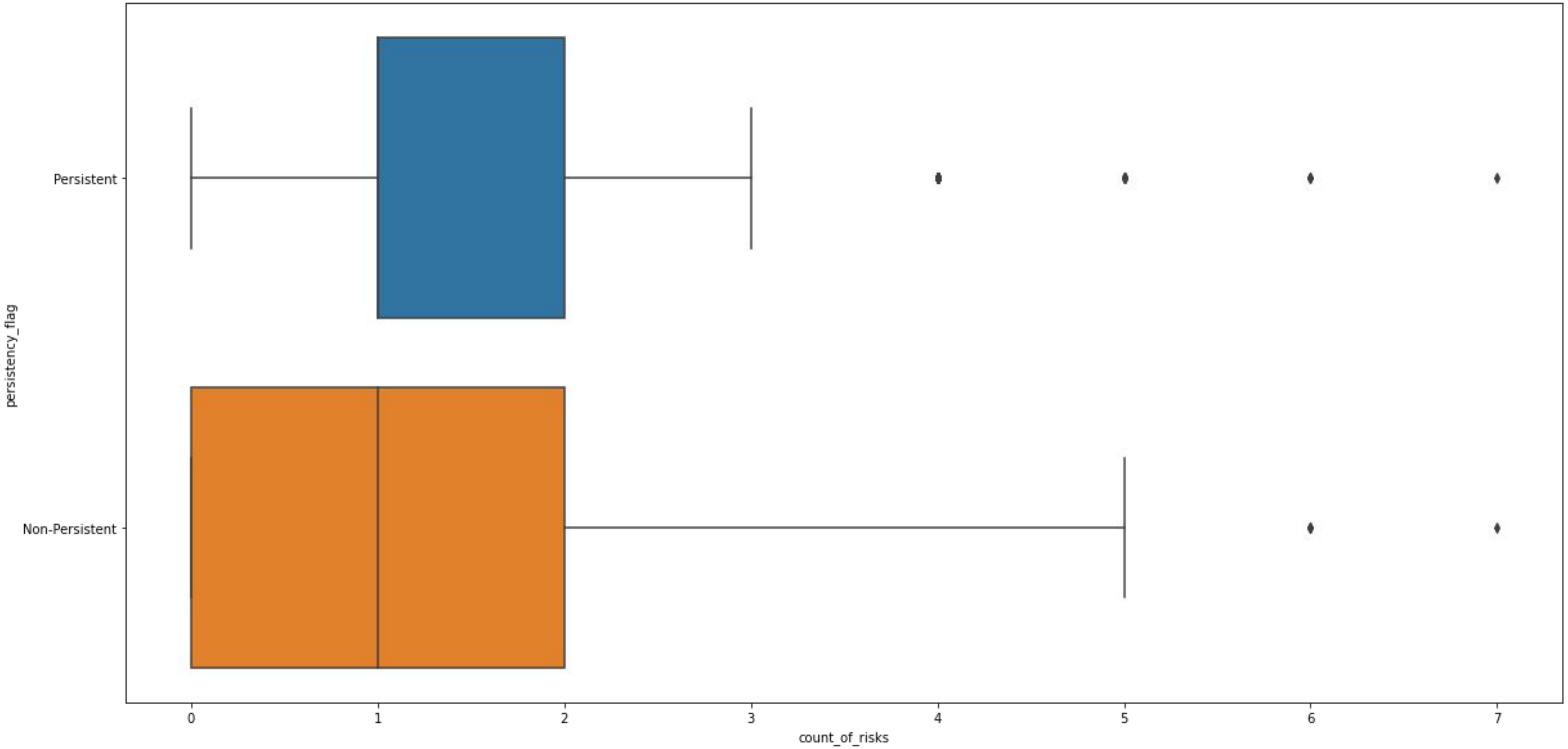
There are no missing values present in the dataset.

Outlier Analysis



Outliers are present in Dexa Frequency during RX .

Outlier Analysis



Outliers are present in Count of Risks.

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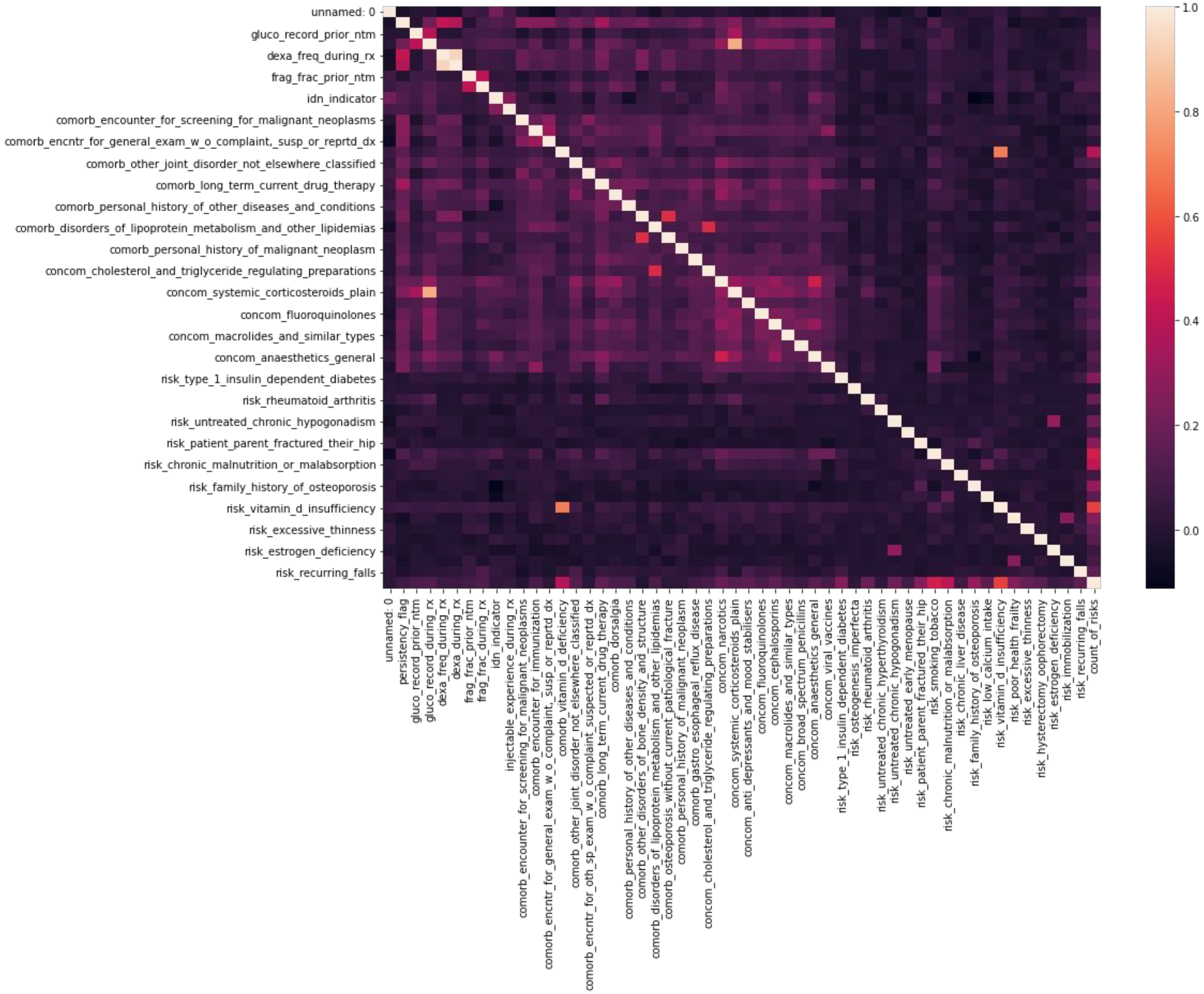
Correlation Analysis
(After Transformation)



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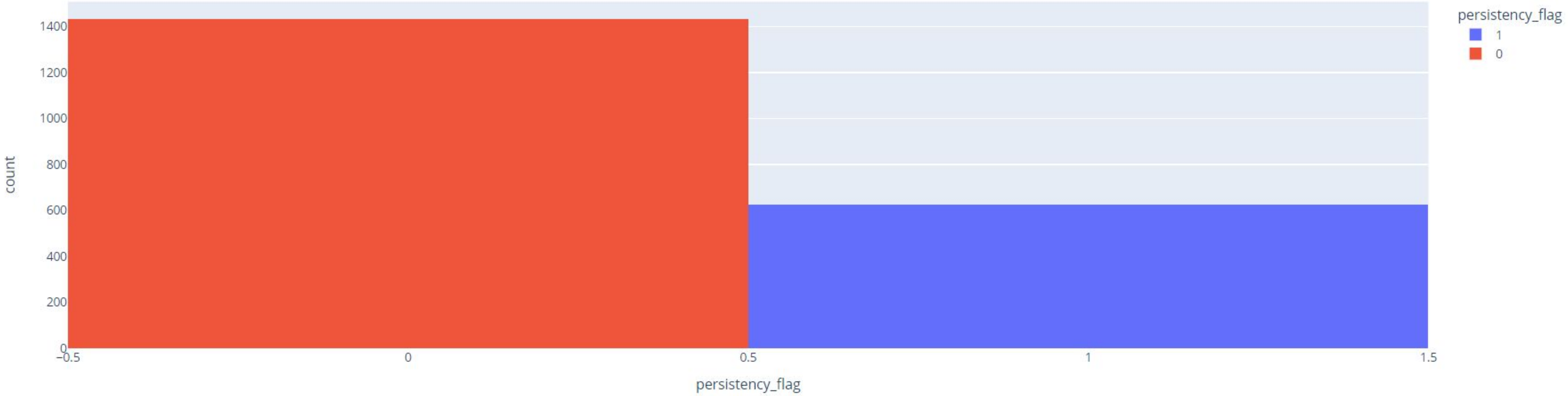
Correlation Analysis
(After Transformation)

```
np.abs(df.corr()).sort_values(by=['persistency_flag'], ascending=False)
```

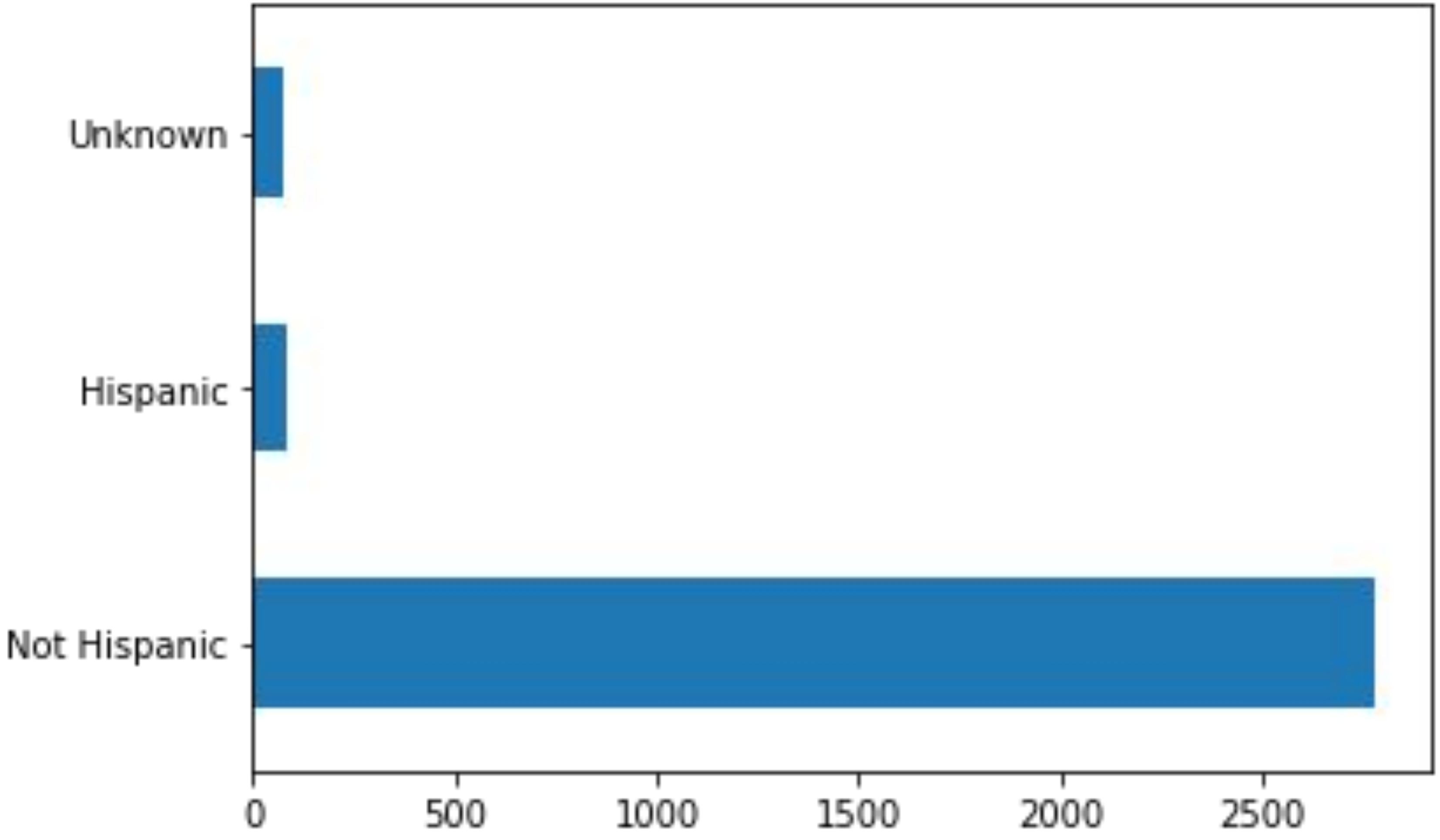
comorb_osteoporosis_without_current_pathological_fracture	0.026532	0.132641	0.026501	0.073092	0.175626	0.181794	0.055280
idn_indicator	0.219046	0.125887	0.082704	0.151895	0.069223	0.062444	0.023204
concom_cholesterol_and_triglyceride_regulating_preparations	0.008783	0.125322	0.056322	0.151519	0.072511	0.070182	0.030236
risk_smoking_tobacco	0.078019	0.115573	0.050013	0.113962	0.067436	0.067105	0.049325
concom_anti_depressants_and_mood_stabilisers	0.010036	0.111728	0.114594	0.183659	0.068515	0.073281	0.057611
frag_frac_during_rx	0.060410	0.102944	0.082551	0.125903	0.074350	0.069782	0.406368
injectable_experience_during_rx	0.095779	0.097495	0.060706	0.127074	0.047364	0.044403	0.034895
count_of_risks	0.020277	0.071565	0.107557	0.125185	0.068723	0.066772	0.087520
risk_vitamin_d_insufficiency	0.050408	0.069520	0.054716	0.052327	0.062477	0.053698	0.057326
risk_rheumatoid_arthritis	0.008757	0.059501	0.081744	0.133258	0.010902	0.005832	0.053564
risk_poor_health_frailty	0.009102	0.055891	0.026172	0.022617	0.013199	0.022940	0.036827
risk_untreated_chronic_hypogonadism	0.053267	0.045216	0.035754	0.034535	0.016361	0.011717	0.022202
risk_immobilization	0.031334	0.042316	0.001762	0.000075	0.023328	0.013253	0.047301
unnamed: 0	1.000000	0.033908	0.001707	0.015618	0.043708	0.039931	0.074663
risk_chronic_malnutrition_or_malabsorption	0.014086	0.031632	0.098274	0.083450	0.027944	0.027883	0.022253
risk_chronic_liver_disease	0.004007	0.029426	0.007700	0.017017	0.020674	0.023942	0.012087
risk_excessive_thinness	0.035151	0.023628	0.008593	0.001548	0.009656	0.004589	0.051566
risk_estrogen_deficiency	0.010587	0.023250	0.002087	0.017821	0.000155	0.009564	0.006254
risk_recurring_falls	0.018737	0.020356	0.005272	0.012869	0.012977	0.022306	0.053616
risk_untreated_chronic_hyperthyroidism	0.030909	0.017246	0.016023	0.045114	0.010639	0.011344	0.011025

Persistence Flag



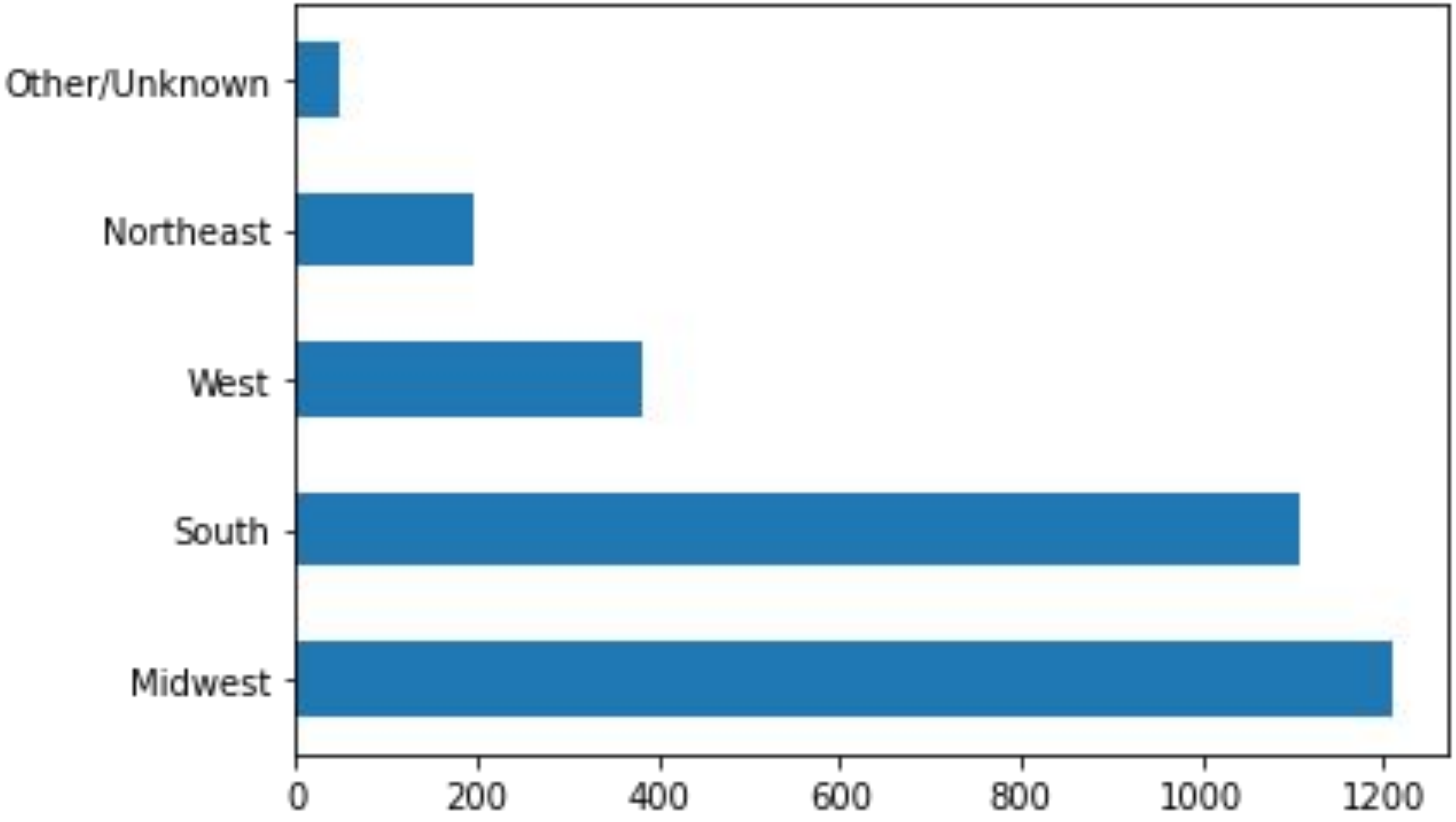
Less drugs are persistent than non-persistent.

Ethnicity Distribution



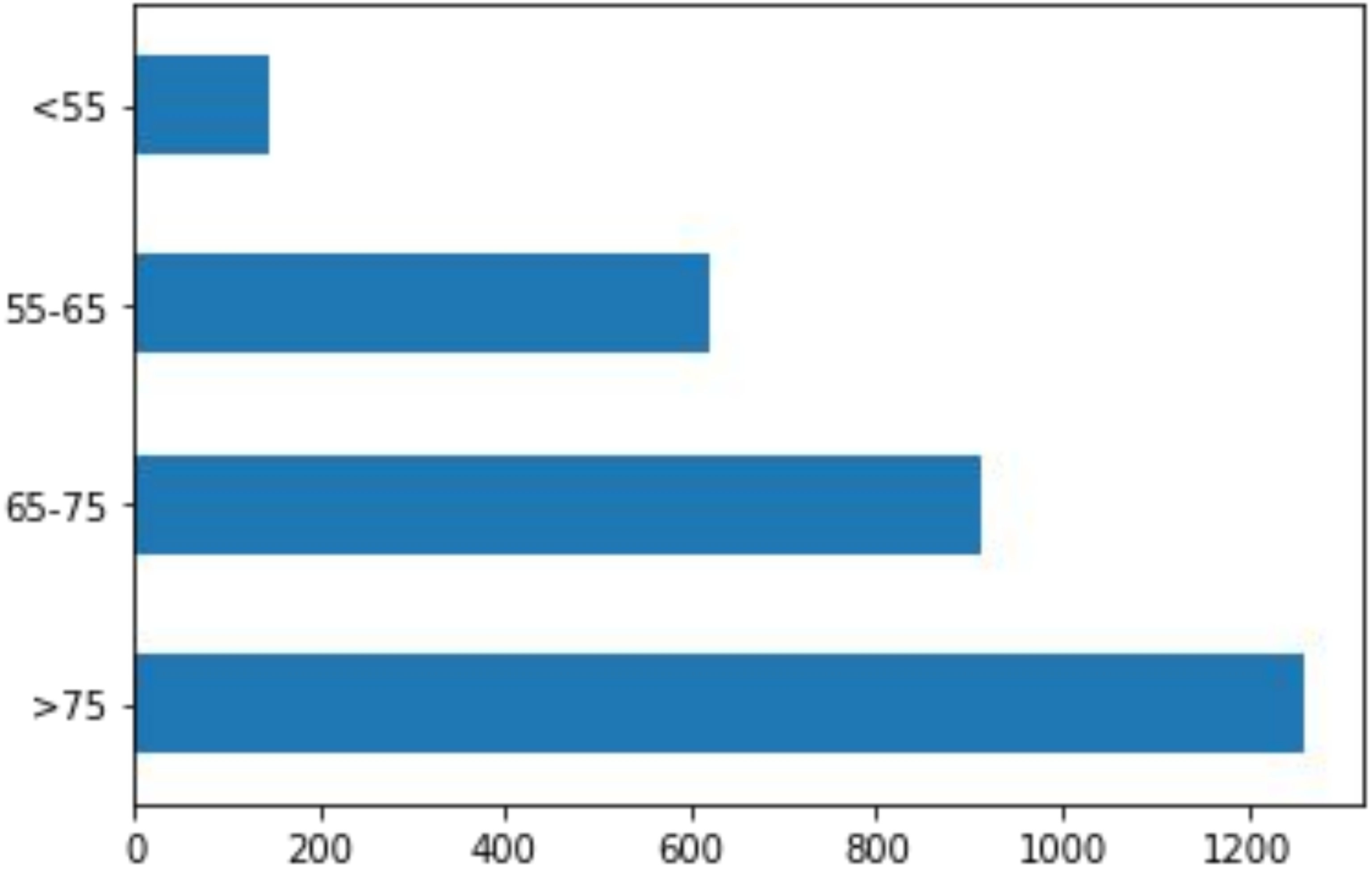
The highest ethnicity is of not hispanic people.

Region wise Distribution



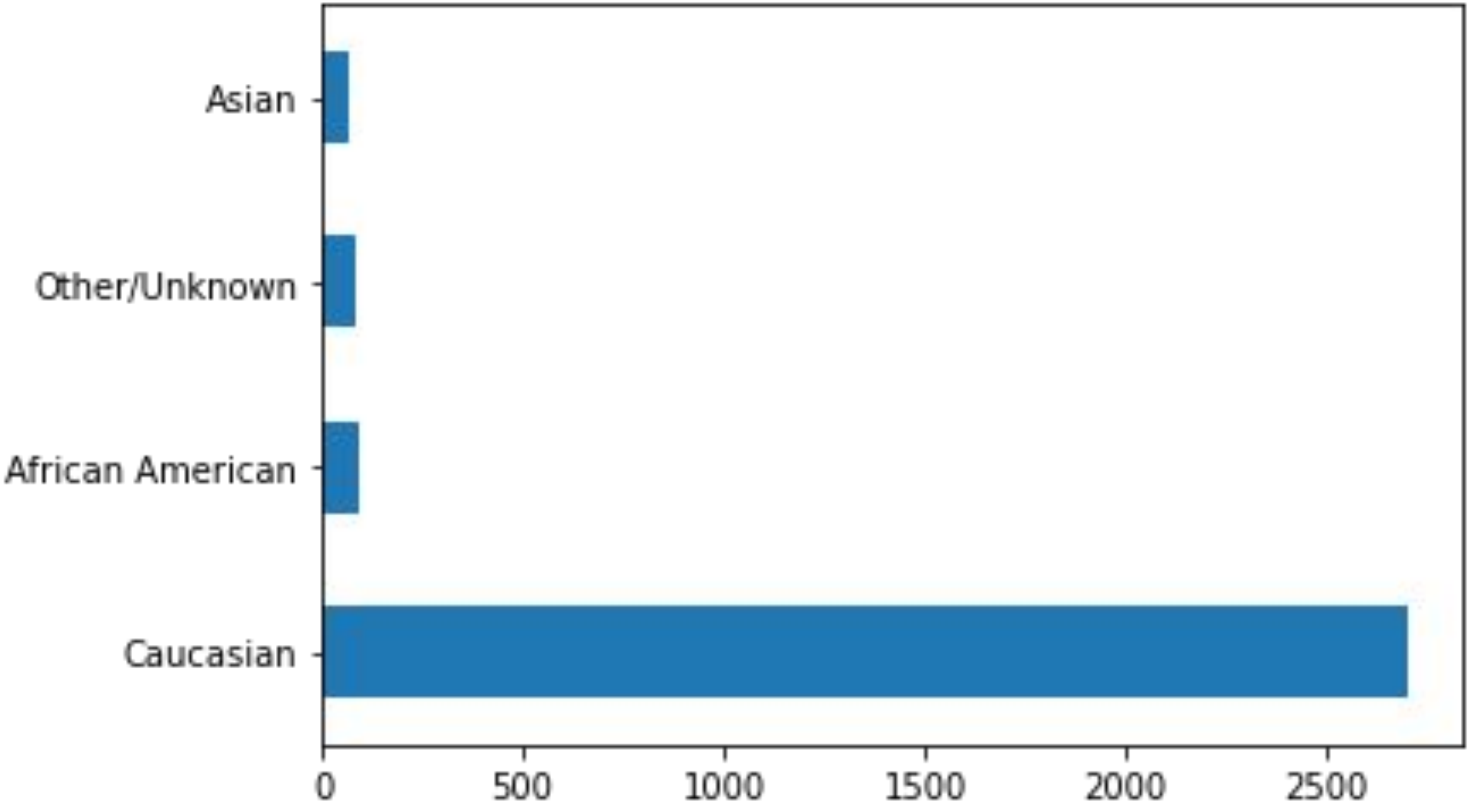
South and Midwest are the dominant regions.

Age analysis



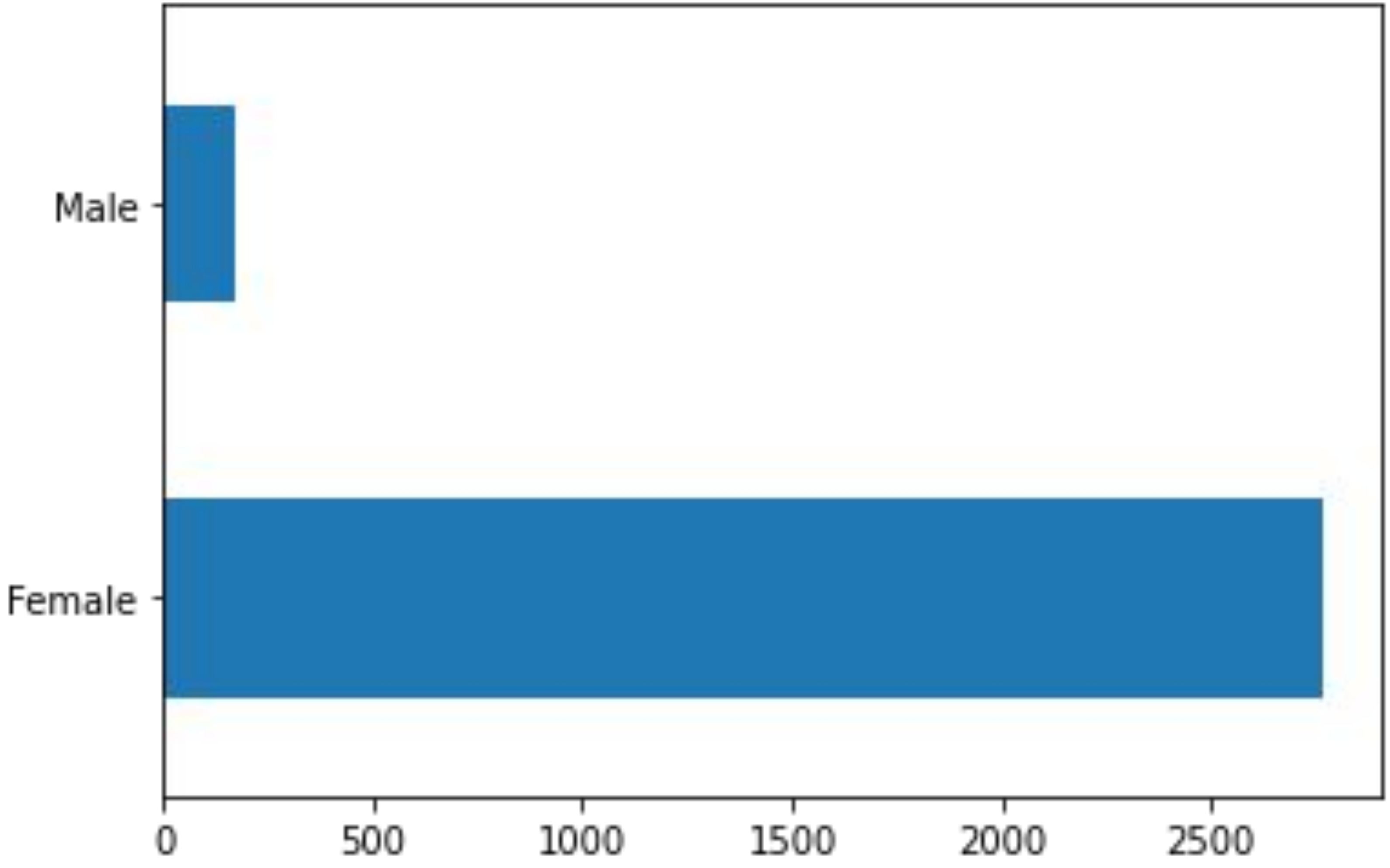
Majority of the patients are above the age of 55 years.

Race Distribution



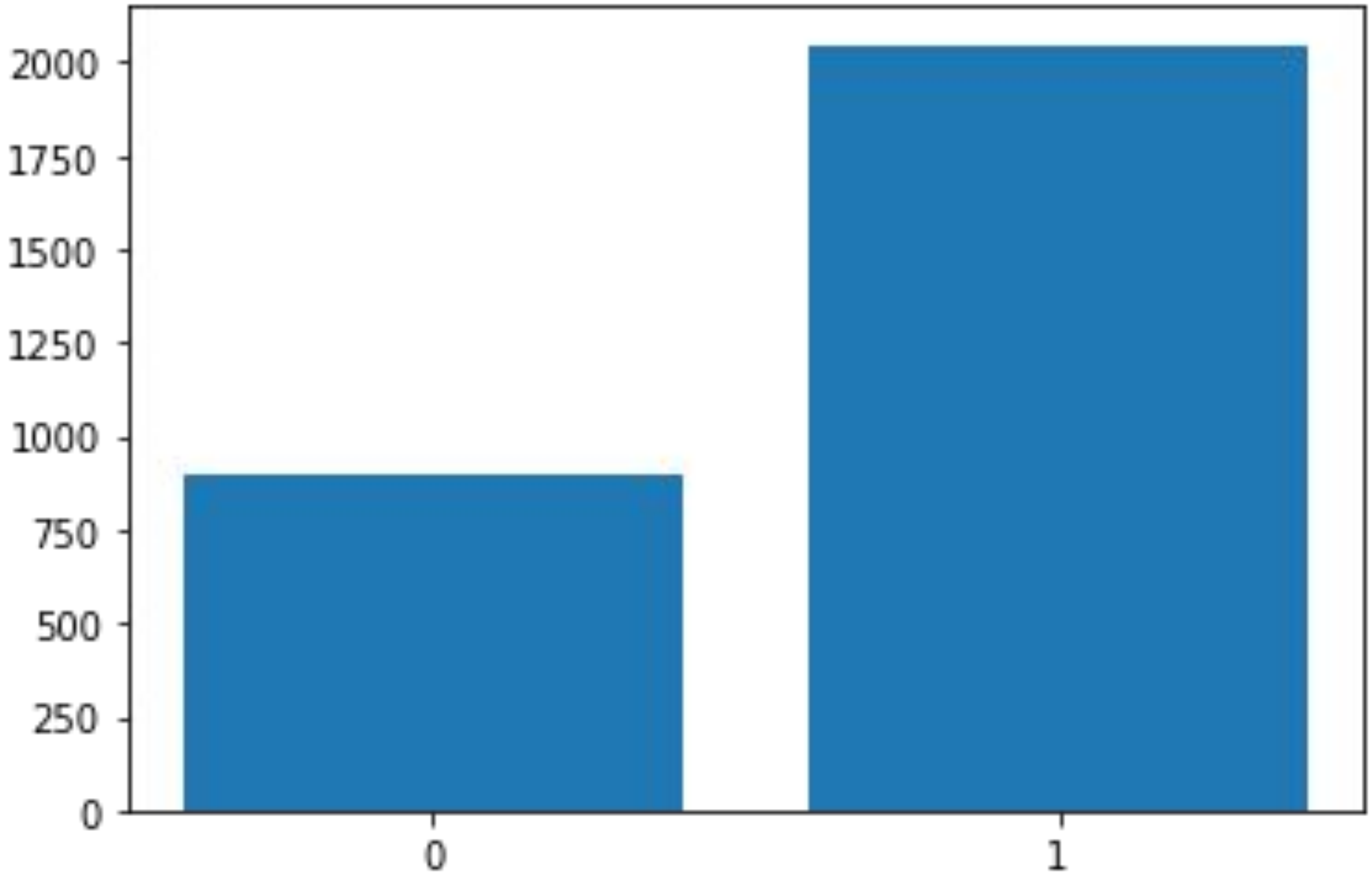
Caucasian race is the most prominent among other races.

Gender Analysis



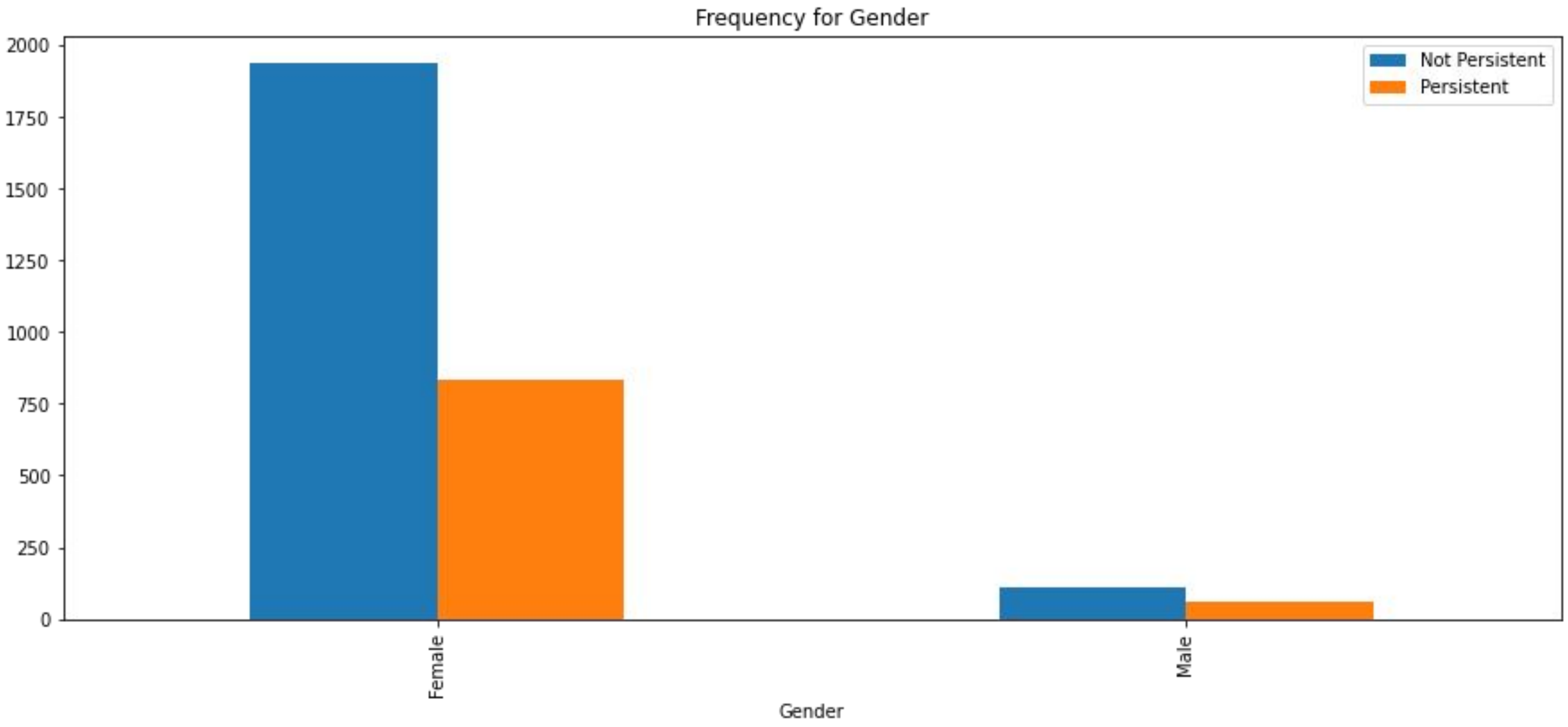
Female patients are considerably more than male patients.

Persistency Flag



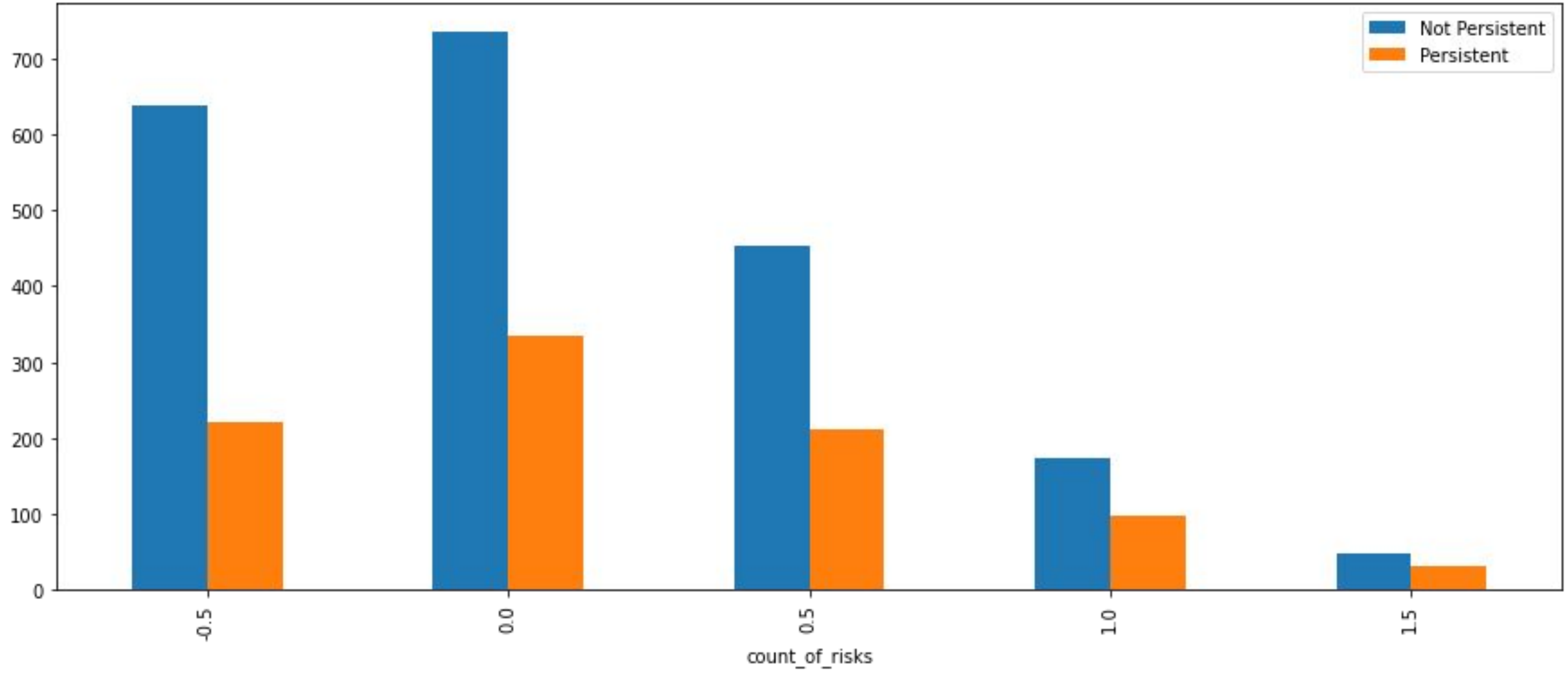
Drugs are more persistent than non-persistent.

Persistency with respect to Gender



Females and males are mostly persistent to the drug.

Risk count with respect to persistency



Number of risks with non-persistent drug is larger than with persistent drug.

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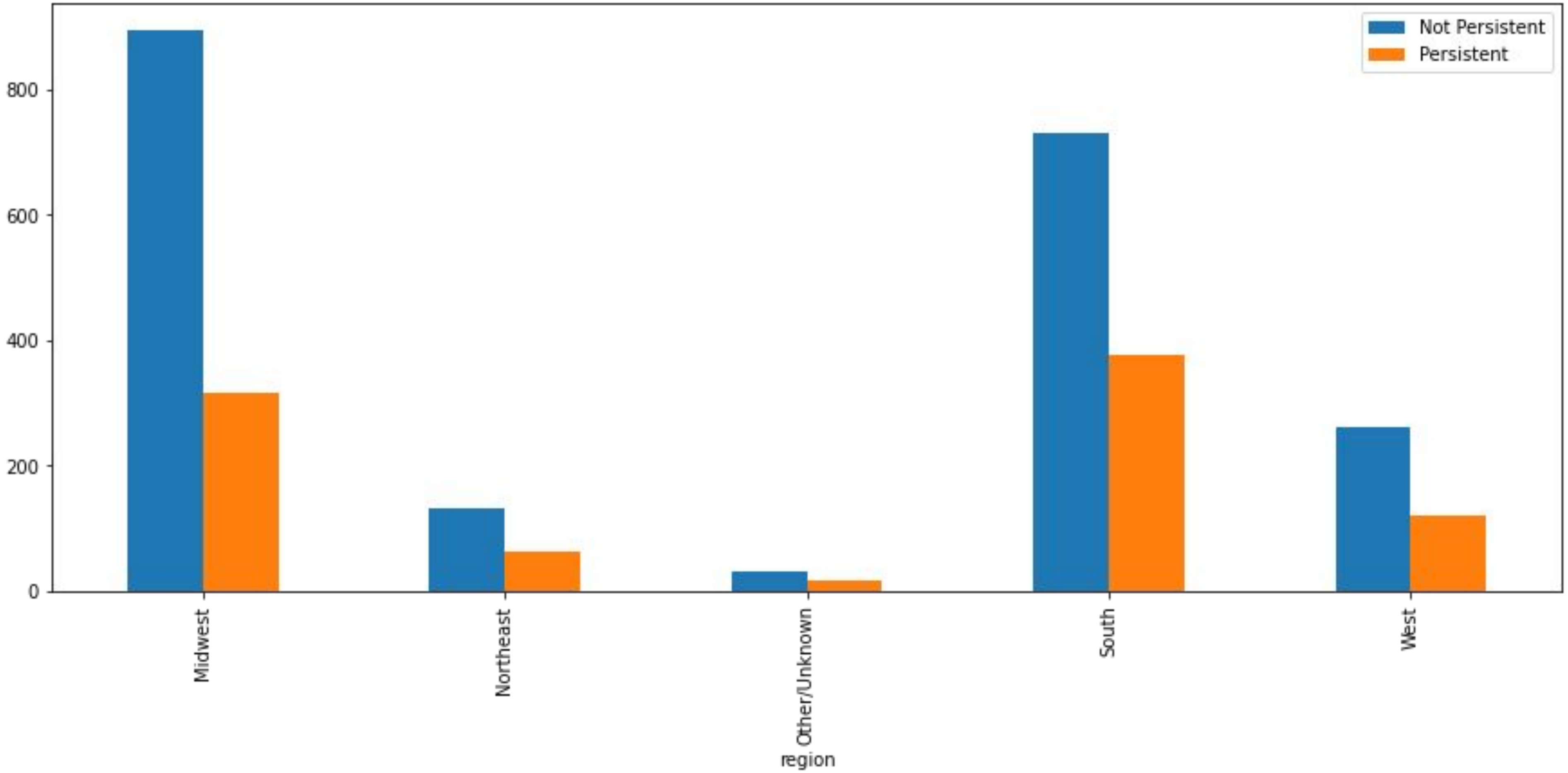
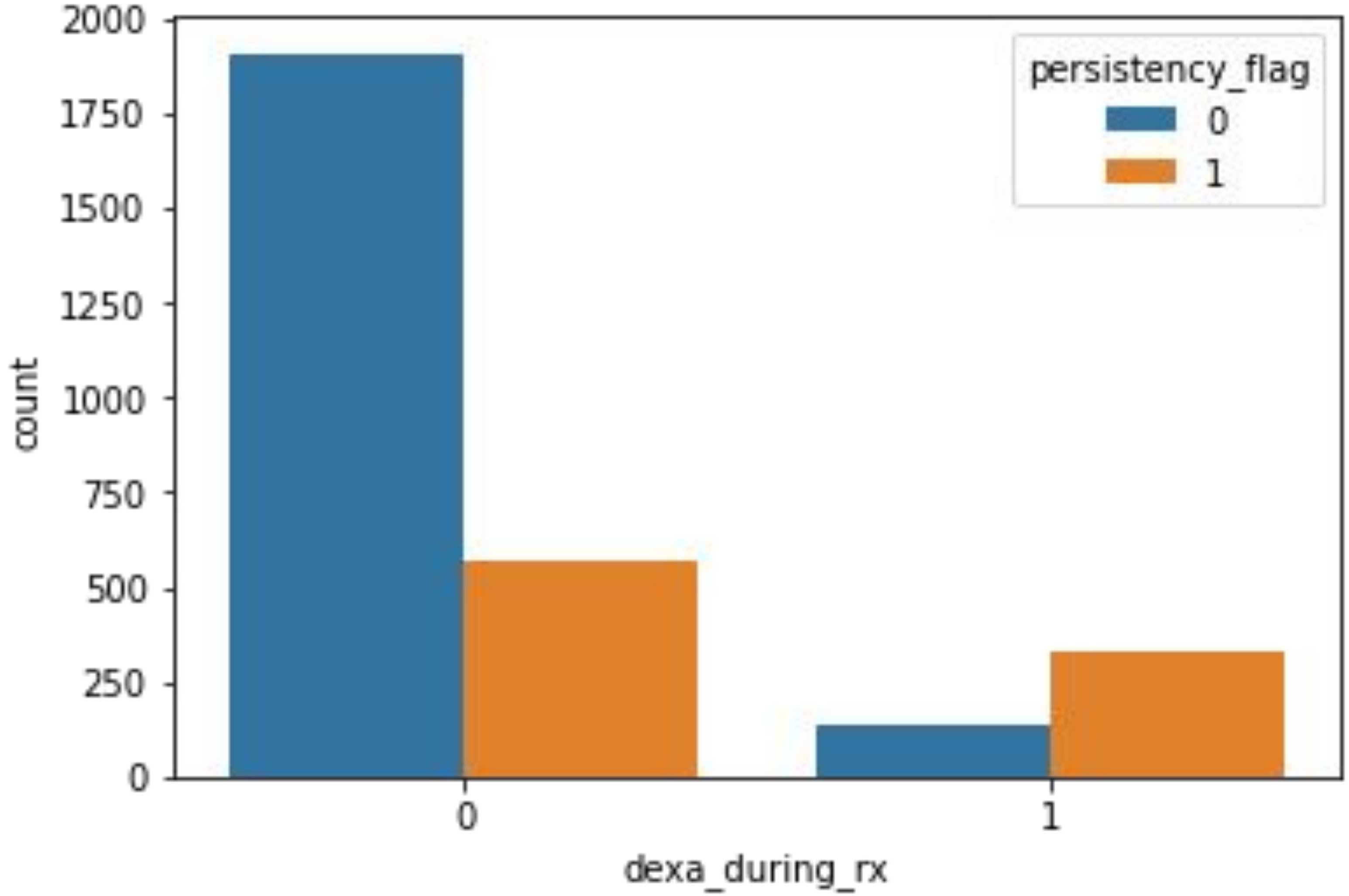
Region wise analysis



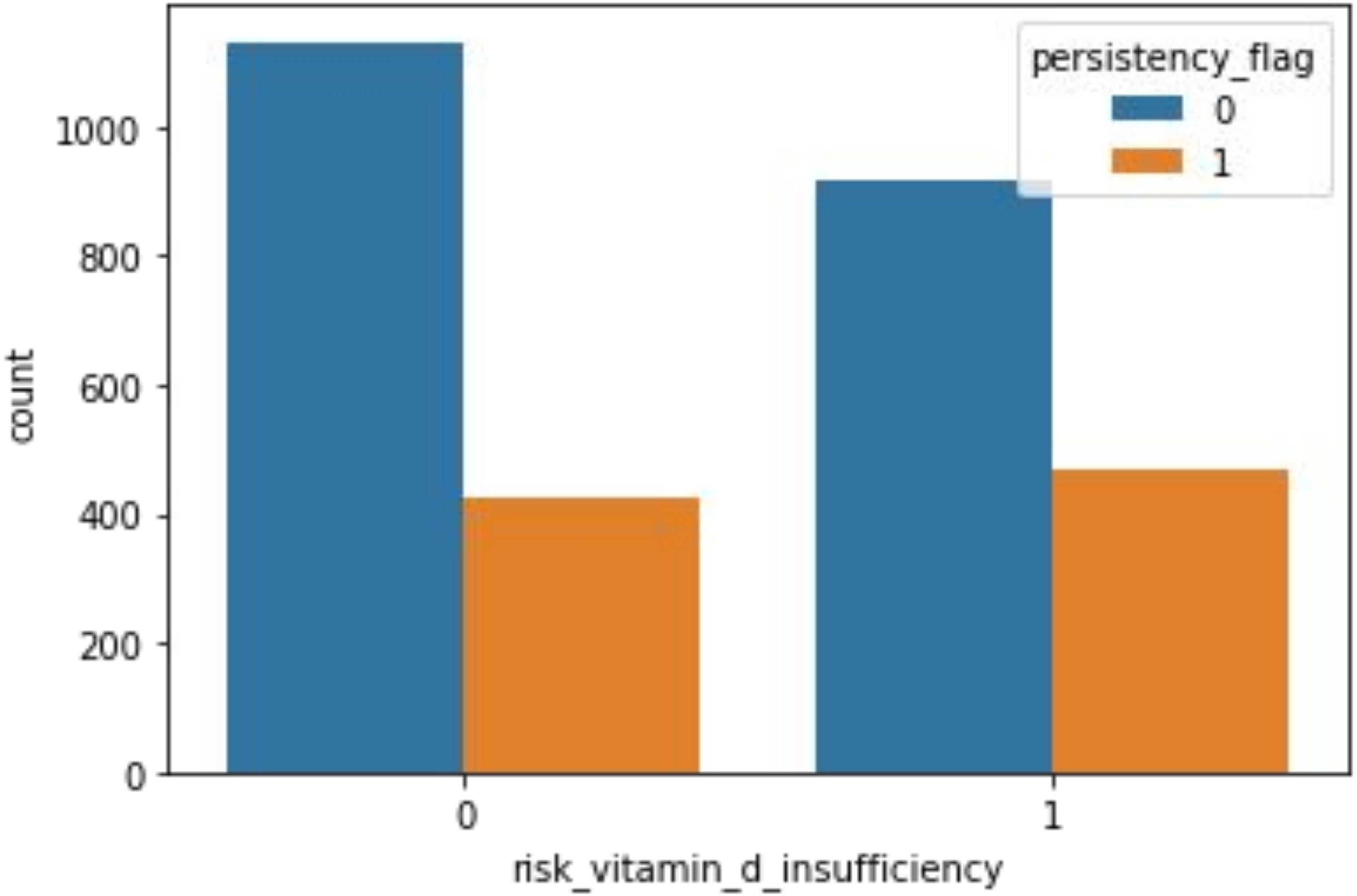
For Midwest vast majority of patients show persistence to the drug.

Patients resistant to drug who had DEXA scan during therapy



Number of patients being persistent to drug with having undergone a DEXA during therapy is high.

Vitamin D Insufficiency Risk



Risk of Vitamin D insufficiency is higher for patients who are non-persistent to the drug.

Model Development and Selection

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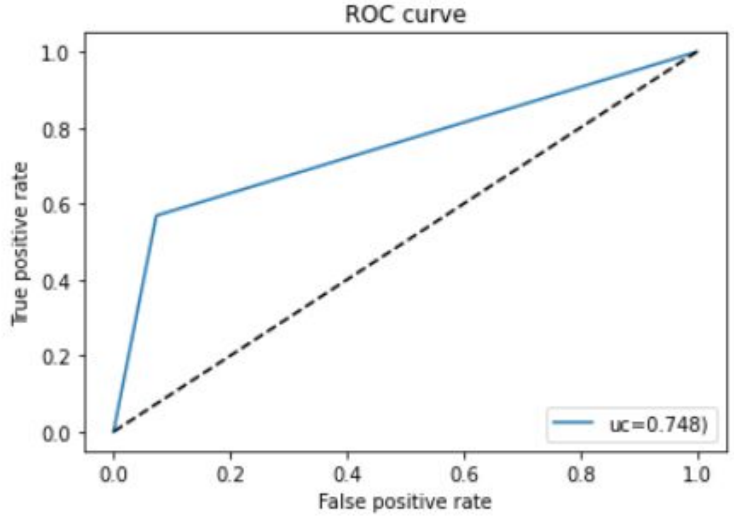
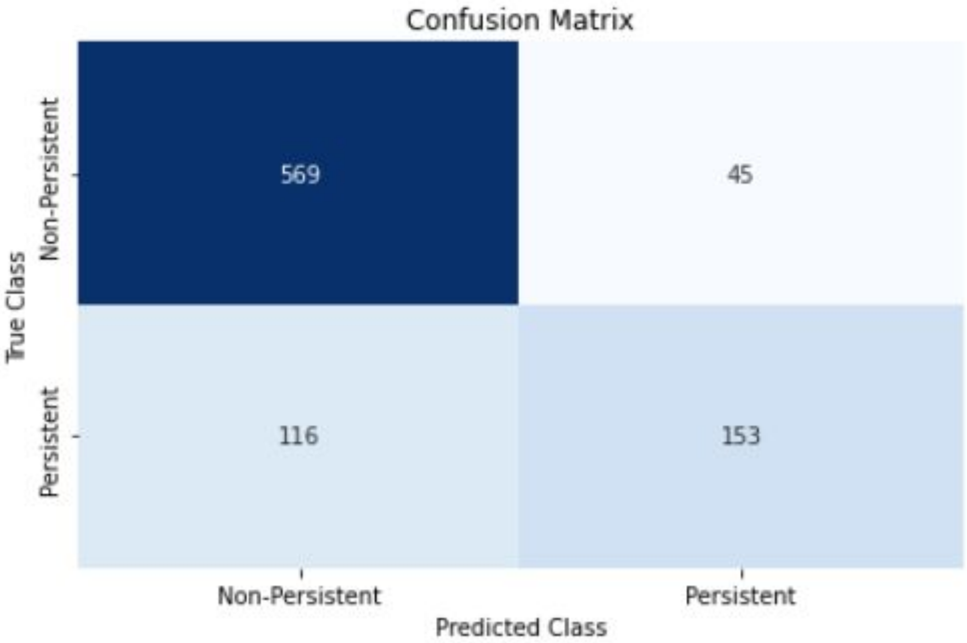
Logistic Regression

```
Accuracy : 0.8176670441676104
Precision : 0.7727272727272727
Recall : 0.5687732342007435
F1 Score : 0.6552462526766595
```

	precision	recall	f1-score	support
Non-Persistent	0.83	0.93	0.88	614
Persistent	0.77	0.57	0.66	269
accuracy			0.82	883
macro avg	0.80	0.75	0.77	883
weighted avg	0.81	0.82	0.81	883

```
AUC : 0.7477416659603066
```



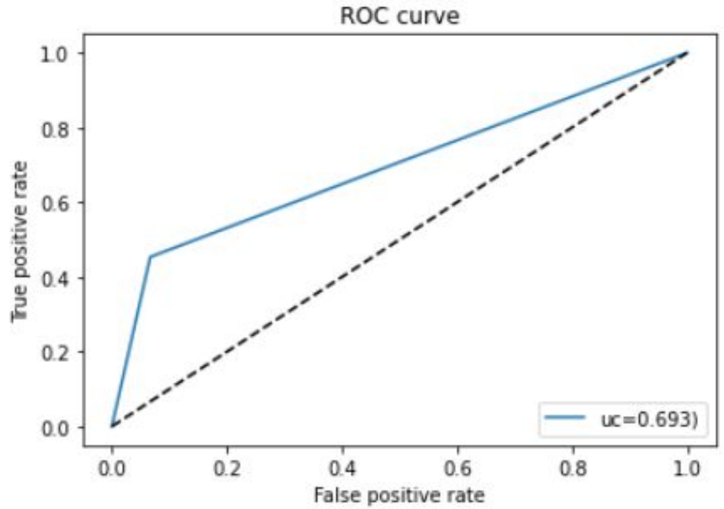


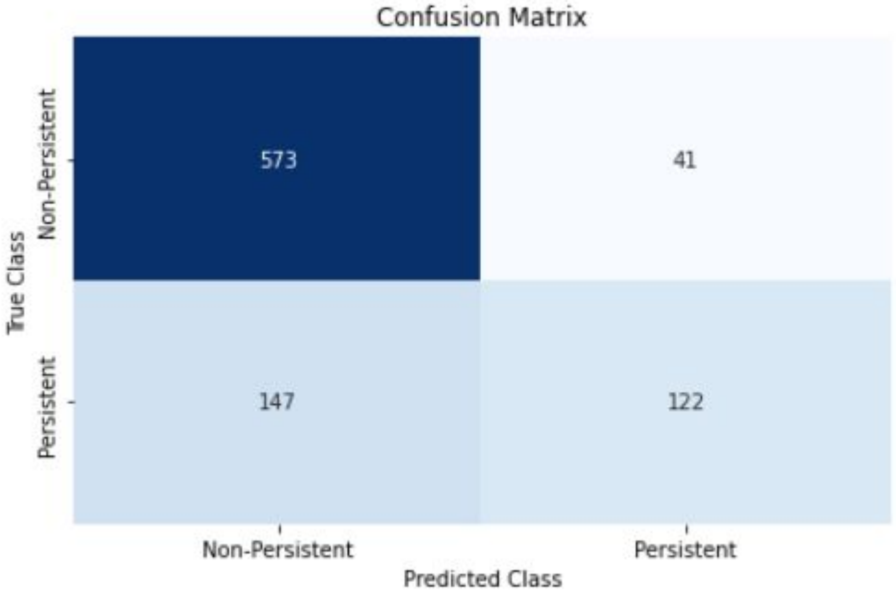
Random Forest Classifier

Accuracy : 0.7870894677236693
Precision : 0.7484662576687117
Recall : 0.45353159851301117
F1 Score : 0.5648148148148148

	precision	recall	f1-score	support
Non-Persistent	0.80	0.93	0.86	614
Persistent	0.75	0.45	0.56	269
accuracy			0.79	883
macro avg	0.77	0.69	0.71	883
weighted avg	0.78	0.79	0.77	883

AUC : 0.6933781771066684



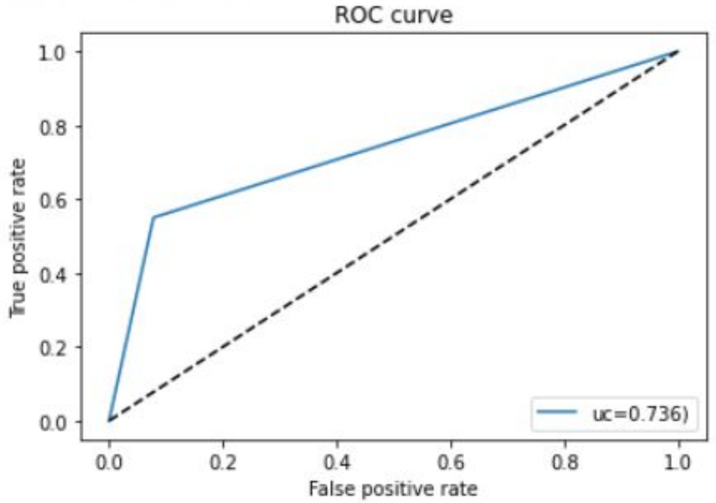


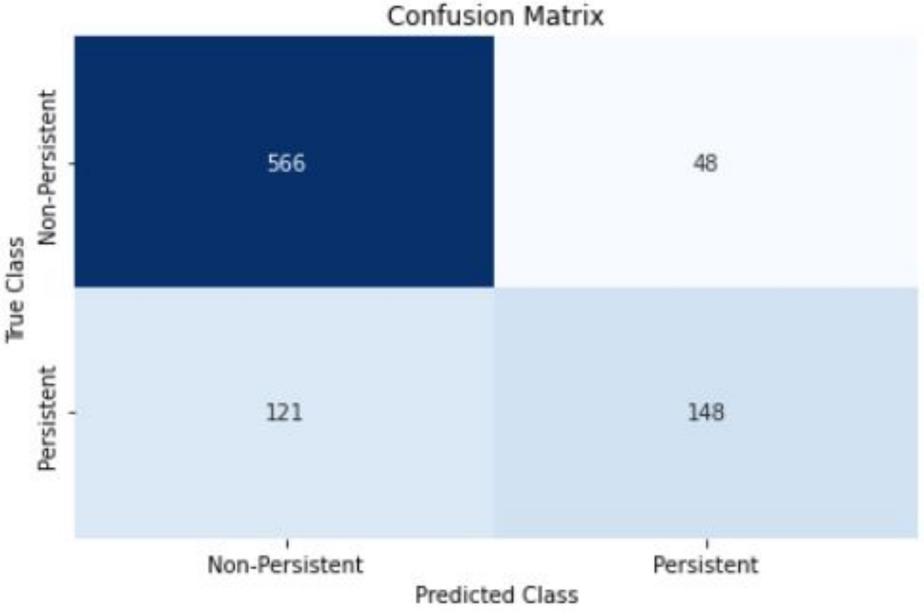
Gradient Boosting Model

Accuracy : 0.8086070215175538
Precision : 0.7551020408163265
Recall : 0.550185873605948
F1 Score : 0.6365591397849463

	precision	recall	f1-score	support
Non-Persistent	0.82	0.92	0.87	614
Persistent	0.76	0.55	0.64	269
accuracy			0.81	883
macro avg	0.79	0.74	0.75	883
weighted avg	0.80	0.81	0.80	883

AUC : 0.7360049889202378





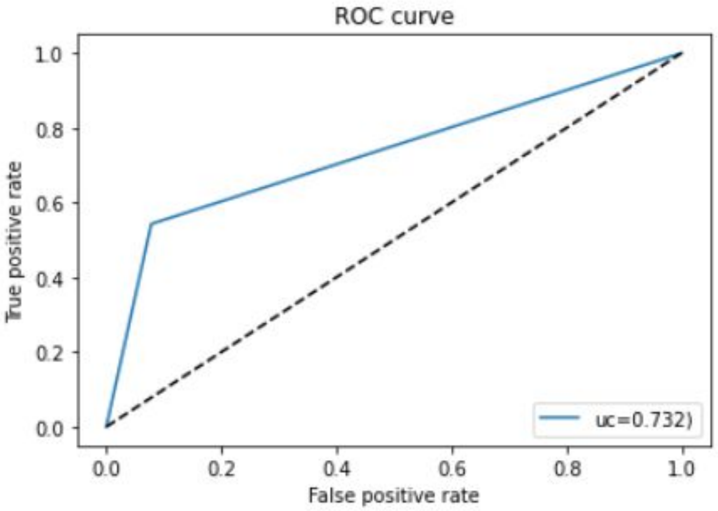
XGBOOST Classifier

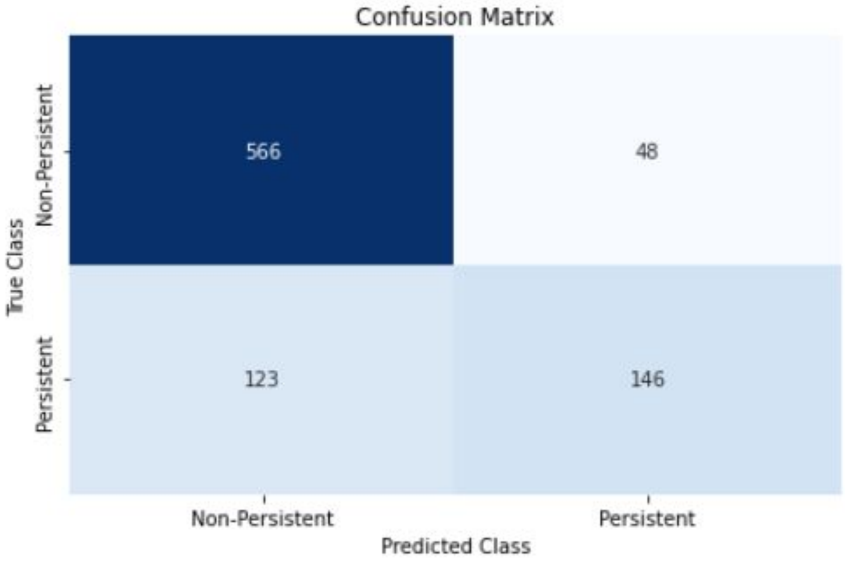
```
Accuracy : 0.8063420158550396
Precision : 0.7525773195876289
Recall : 0.5427509293680297
F1 Score : 0.6306695464362851
               precision    recall  f1-score   support

Non-Persistent       0.82      0.92      0.87       614
    Persistent       0.75      0.54      0.63       269

      accuracy                           0.81       883
     macro avg       0.79      0.73      0.75       883
  weighted avg       0.80      0.81      0.80       883

AUC : 0.7322875168012787
```





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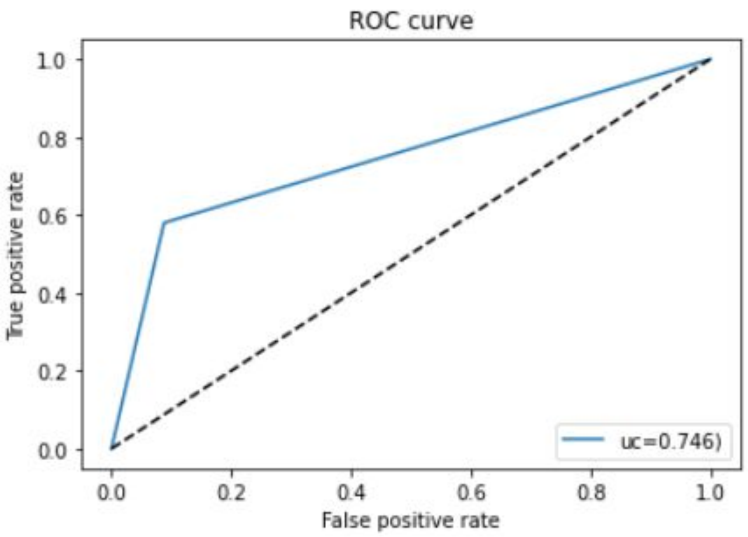
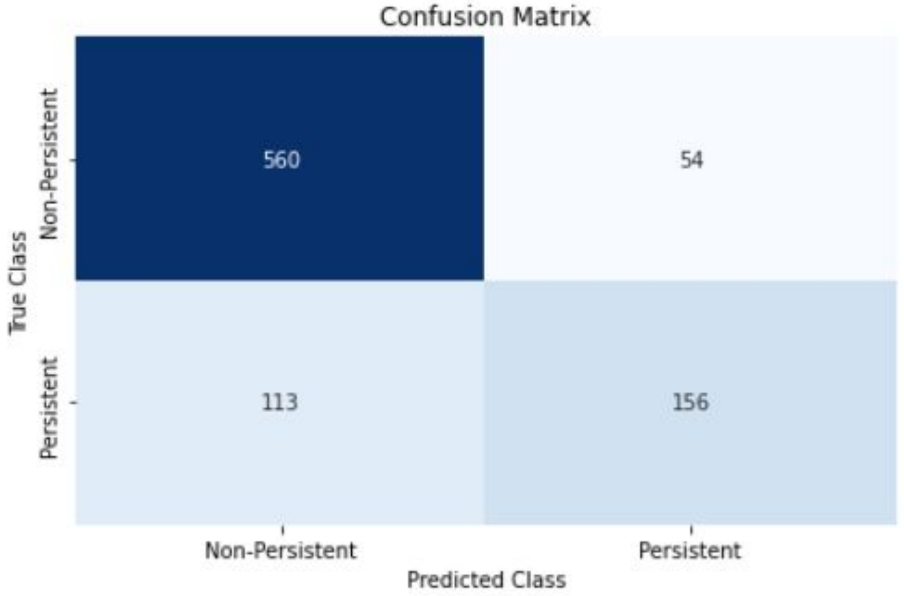
AdaBoost Classifier

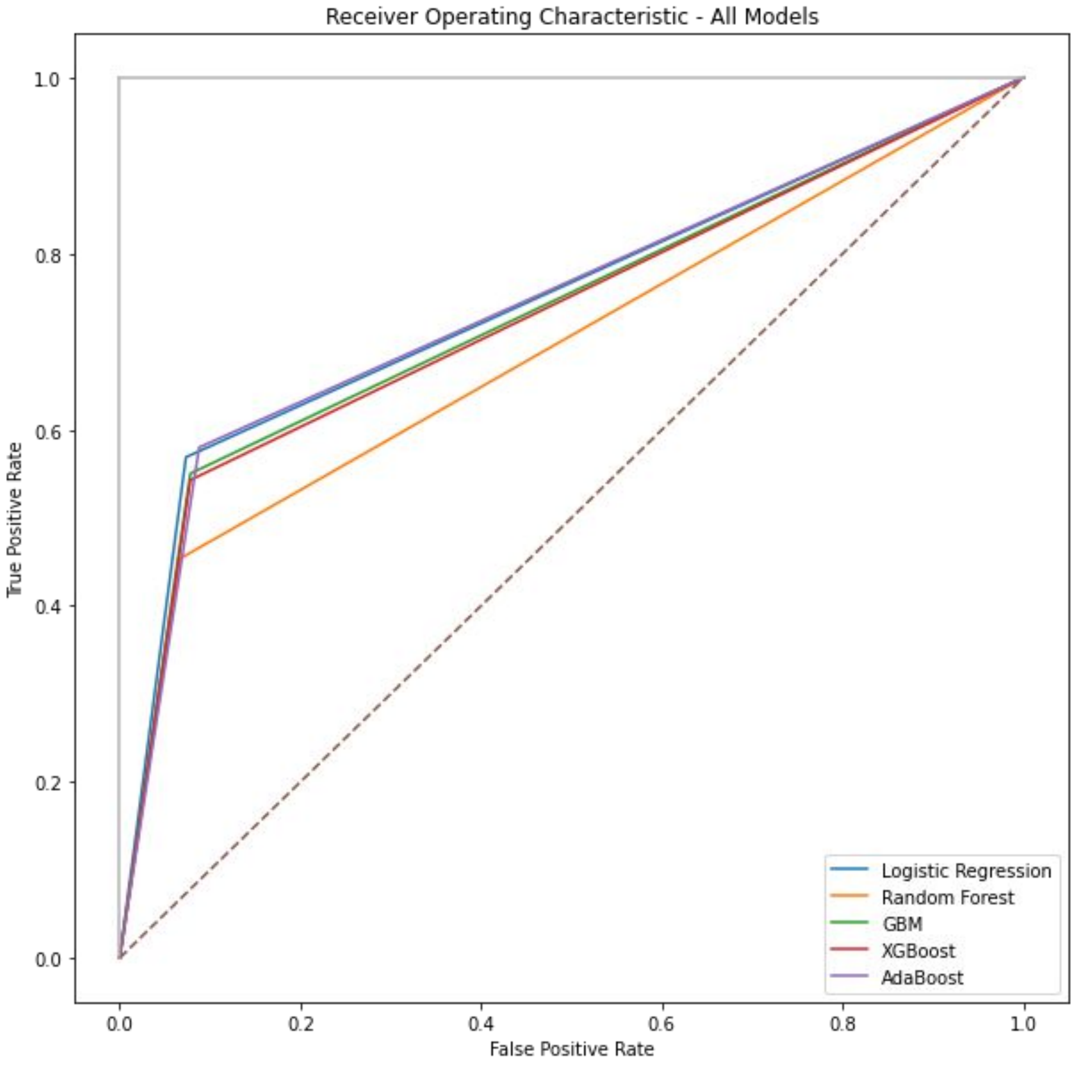
```
Accuracy : 0.8108720271800679
Precision : 0.7428571428571429
Recall : 0.5799256505576208
F1 Score : 0.6513569937369519
               precision    recall  f1-score   support

Non-Persistent       0.83      0.91      0.87       614
    Persistent       0.74      0.58      0.65       269

      accuracy                           0.81       883
     macro avg       0.79      0.75      0.76       883
  weighted avg       0.80      0.81      0.80       883

AUC : 0.7459888839107323
```





Evaluation of Models

ROC Curves



Receiver Operating Characteristic - All Models
1.0
0.8
0.6
0.4
0.2
0.0
True Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
False Positive Rate
Logistic Regression
Random Forest
GBM
XGBoost
AdaBoost

ROC area under the curve values

```
roc_auc_score for Logistic Regression:  0.7477416659603066
roc_auc_score for Random Forest:  0.6933781771066684
roc_auc_score for GBM:  0.7360049889202378
roc_auc_score for XGBOOST:  0.7322875168012787
roc_auc_score for ADABoost:  0.7459888839107323
```

Conclusion

Recommendation

The given dataset was cleaned and transformed for the classification problem.

Then it was split into two sets as train set and test set. Next, different models were trained and tested like Logistic Regression, Random Forest Model, Gradient Boosting Model, XGBoost and AdaBoost Models.

From the above comparisons, it can be concluded that:

Logistic Regression Model is the best fit model to the dataset with accuracy score 0.817. Closely followed by AdaBoost Classification Model with accuracy score 0.81 and Gradient Boosting Model with accuracy score 0.808.

Thank You