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Exploratory Data Analysis & Modeling Proposal

Healthcare: Persistency of a drug (Data Science)

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Agenda

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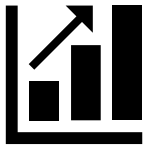
Problem Statement

- ABC is a pharmaceutical company. Medication persistency following a patient’s doctor's prescription is a problem that ABC, a pharmaceutical company, wants to comprehend. Persistence of drugs is the duration of time a patient takes medication, from initiation to discontinuation of therapy. To automate this identifying process, this organization has contacted an analytics firm.
- The analytics firm has to create a classification for the given dataset with the aim of gathering insights on the factors that are affecting the persistency.

Datasets Exploration

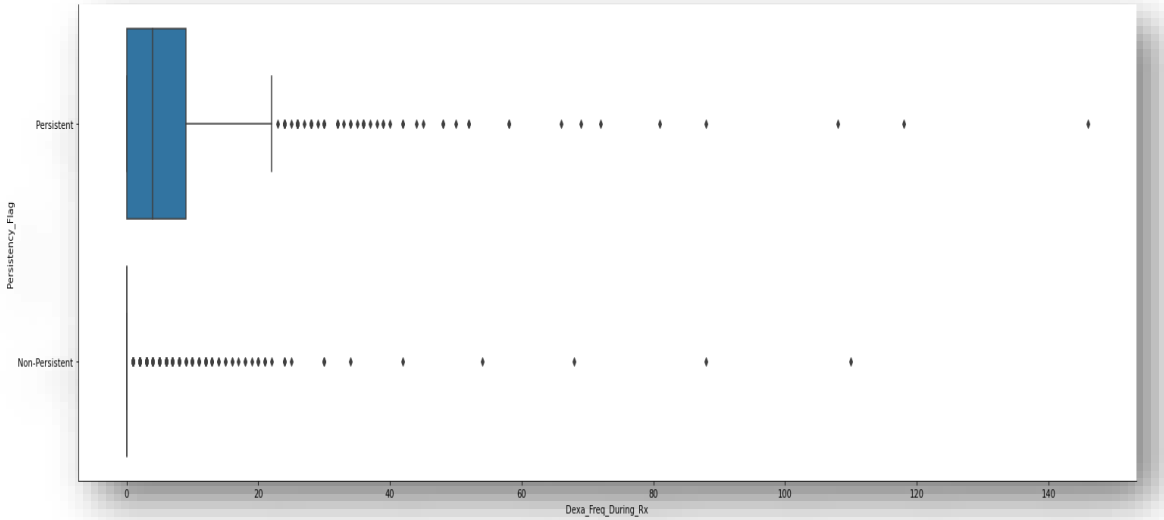
- The dataset contains 3423 observations with 26 columns and 68 features.
- It contains demographic information, clinical data, other diseases as risk factor information, and information on their physician's specialty for each patient.
- There are two numerical columns in the dataset, per the data type description. Which are:
  - **Dexa_Freq_During_Rx**
  - **Count_Of_Risks**
- The Target Variable: **Persistency_Flag**
- The dataset does not contain any NA values.

EDA

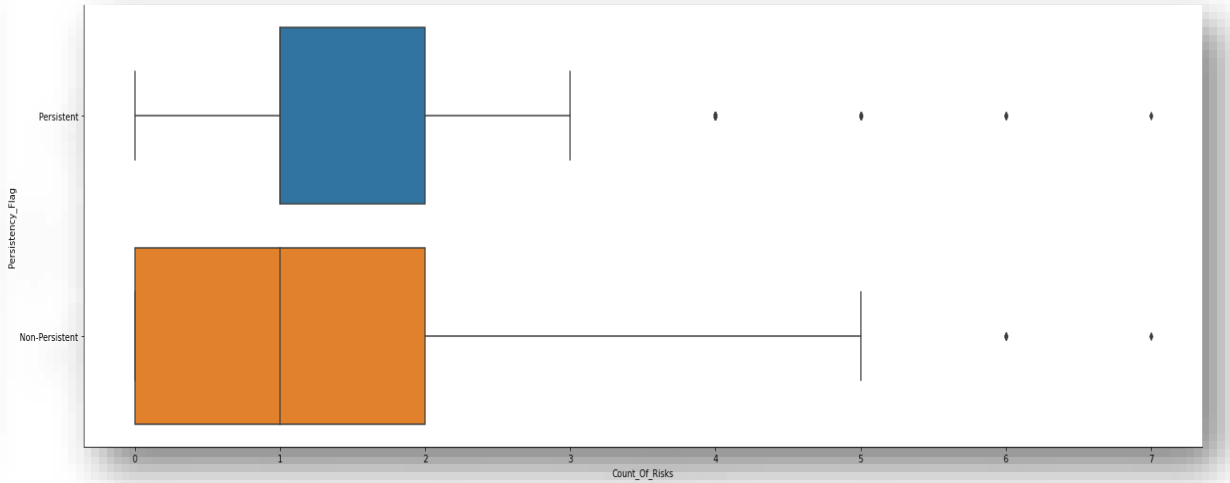


Outlier Analysis

Dexa_Freq_During_Rx



Count_Of_Risks



- Both numerical features contain some outliers.
- I performed the Capping and the Trimming/Removing techniques to deal with the outliers.
- After removing the outliers in the Count_Of_Risks column, the number of rows in the dataset was reduced from 3424 to 3401.

Skewness & Kurtosis Analysis

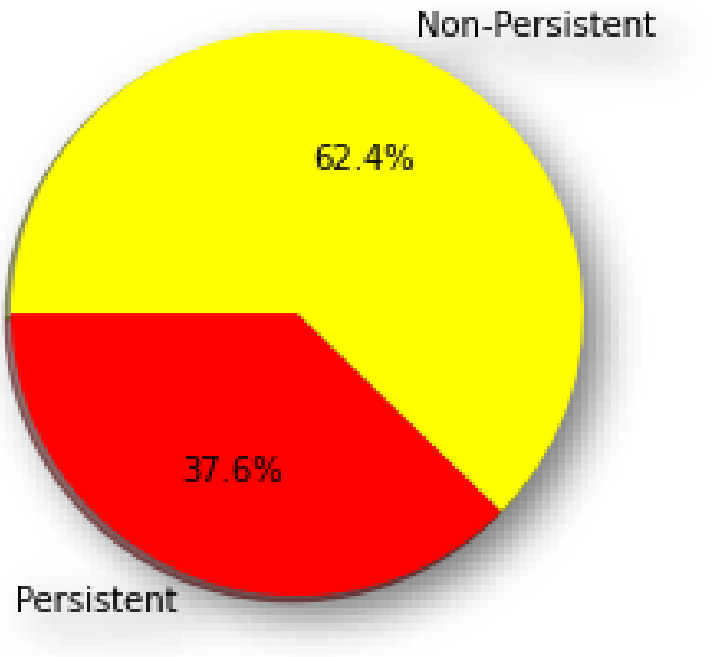
Count_Of_Risks

- ✓The Count_Of_Risks distribution is moderately skewed. (0.879)
- ✓The Count_Of_Risks distribution is *Platykurtic* (kurtosis <3).
- ✓Compared to a normal distribution, its tails are shorter and thinner, and often its central peak is lower and broader. (0.900)

Dexa_Freq_During_Rx

- ✓The Dexa_Freq_During_Rx distribution is highly skewed. (6.808)
- ✓The Dexa_Freq_During_Rx distribution is *Leptokurtic* (kurtosis >3).
- ✓Compared to a normal distribution, its tails are longer and fatter, and often its central peak is higher and sharper. (74.758)

Univariate Analysis: Exploring the target variable



- The target variable of the dataset is *Persistency_Flag*, - a flag indicating if a patient was persistent or not. The number of unique values in Persistency_Flag variable is 2. The two unique values are Persistent and Non_Persistent.
- There are 2135 non-persistent patients and 1289 persistent patients in this sample.
- Out of the total number of Persistency_Flag values, Non_Persistent appears 62.5% times and Persistent appears 37.5% times.

Bivariate Analysis: Demographical Feature Analysis according to the Persistency_Flag

Gender

Persistency_Flag	Persistency_Flag	
Gender	Non-Persistent	Persistent
Female	2010	1199
Male	115	77

Age Bucket

Persistency_Flag	Persistency_Flag	
Age_Bucket	Non-Persistent	Persistent
55-65	470	259
65-75	647	427
<55	101	63
>75	907	527

- Non-persistent patients are more common in both genders than persistent patients.
- The majority of persistent and non-persistent patients are over the age of 75.

Ethnicity

Persistency_Flag	Non-Persistent	Persistent
Ethnicity		
Hispanic	65	32
Not Hispanic	1999	1215
Unknown	61	29

Race

Persistency_Flag	Non-Persistent	Persistent
Race		
African American	65	29
Asian	43	41
Caucasian	1953	1174
Other/Unknown	64	32

Region

Persistency_Flag	Non-Persistent	Persistent
Region		
Midwest	932	447
Northeast	133	97
Other/Unknown	35	25
South	749	485
West	276	222

- The majority of persistent and non-persistent patients are Not Hispanic.
- Caucasian patients make up the vast majority of both persistent and non-persistent patients.
- The majority of persistent patients are from the Midwest, while the majority of non-persistent patients are from the South.

Risk, Comorbidity and Concomitant feature Analysis

- Comorbidity factors are present in the majority of patients, whereas risk factors are less common.
- The disorders of lipoprotein metabolism and other lipidemias (51.4%) is the most common comorbidity trait.
- Vitamin D deficiency is the leading risk factor (47.4%).
- Narcotics were found in 35.7% of the people. It is also the main concomitant feature.

Patients' Health improvement Analysis according to Persistency_Flag

Change_T_Score

Persistency_Flag Change_T_Score	Non-Persistent	Persistent
Improved	28	66
No change	951	692
Unknown	1080	413
Worsened	66	105

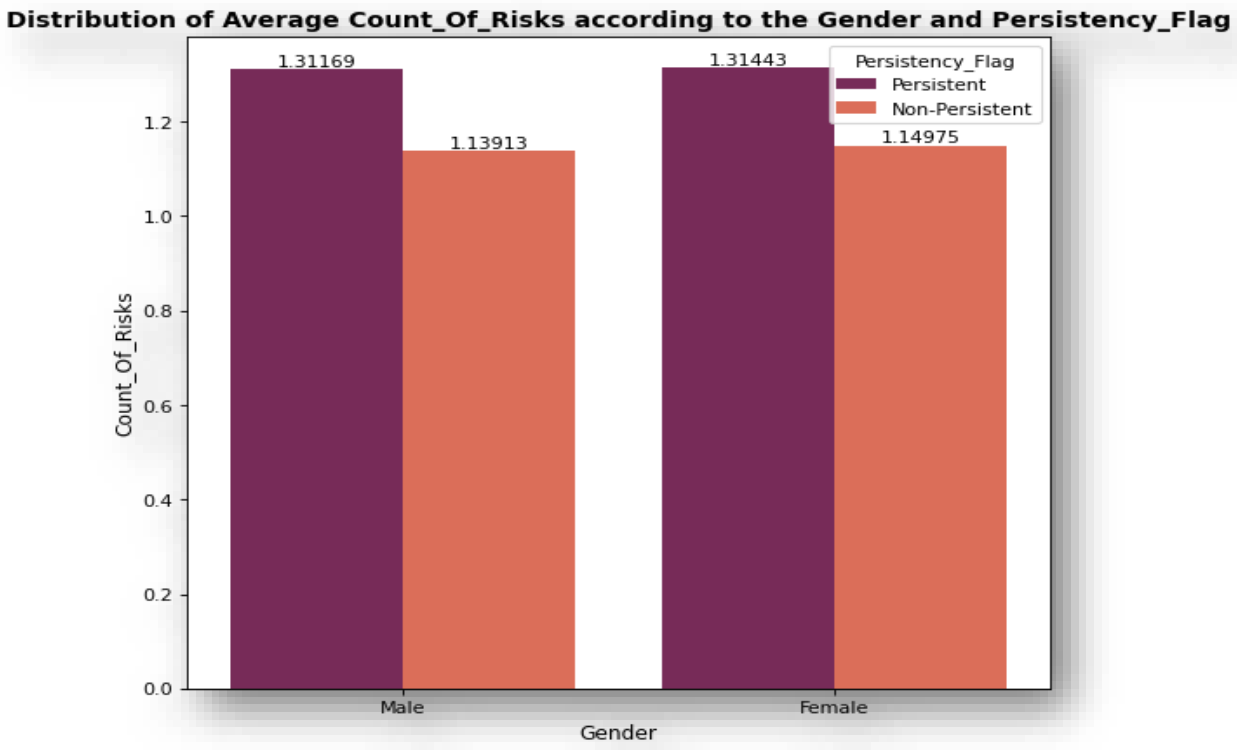
Change_Risk_Segment

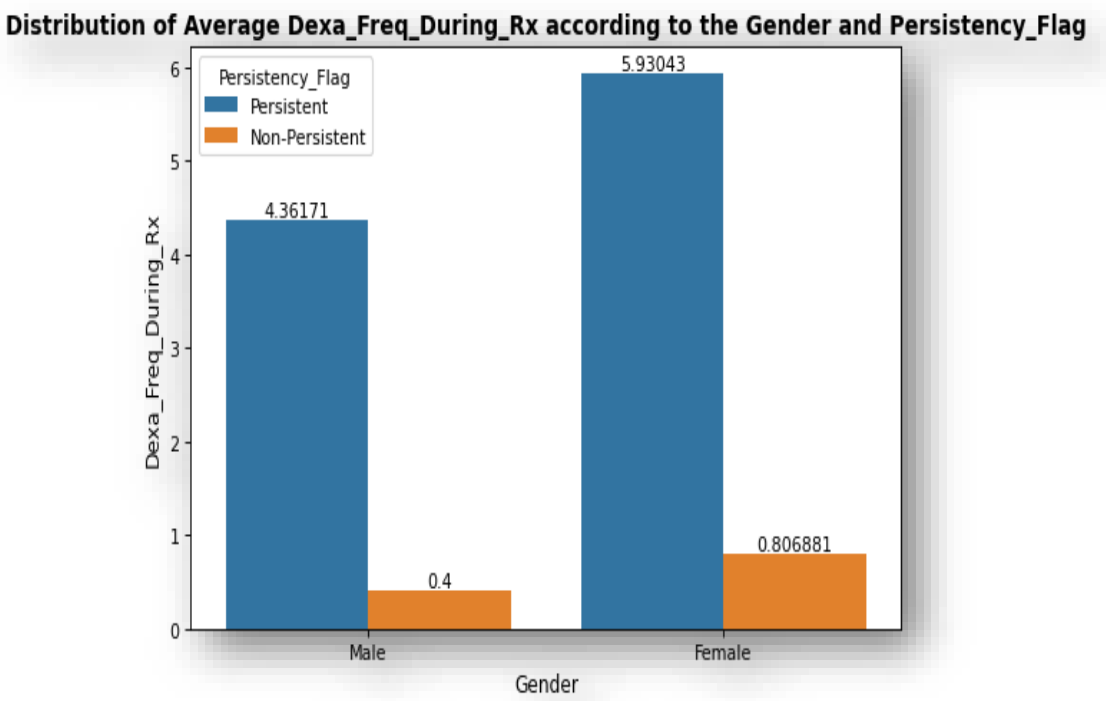
Persistency_Flag Change_Risk_Segment	Non-Persistent	Persistent
Improved	9	13
No change	615	425
Unknown	1453	765
Worsened	48	73

- The majority of persistent patients have T scores that stay unchanged after starting treatment.
- A least amount of persistent and non persistent patients have improved change in Risk Segment.

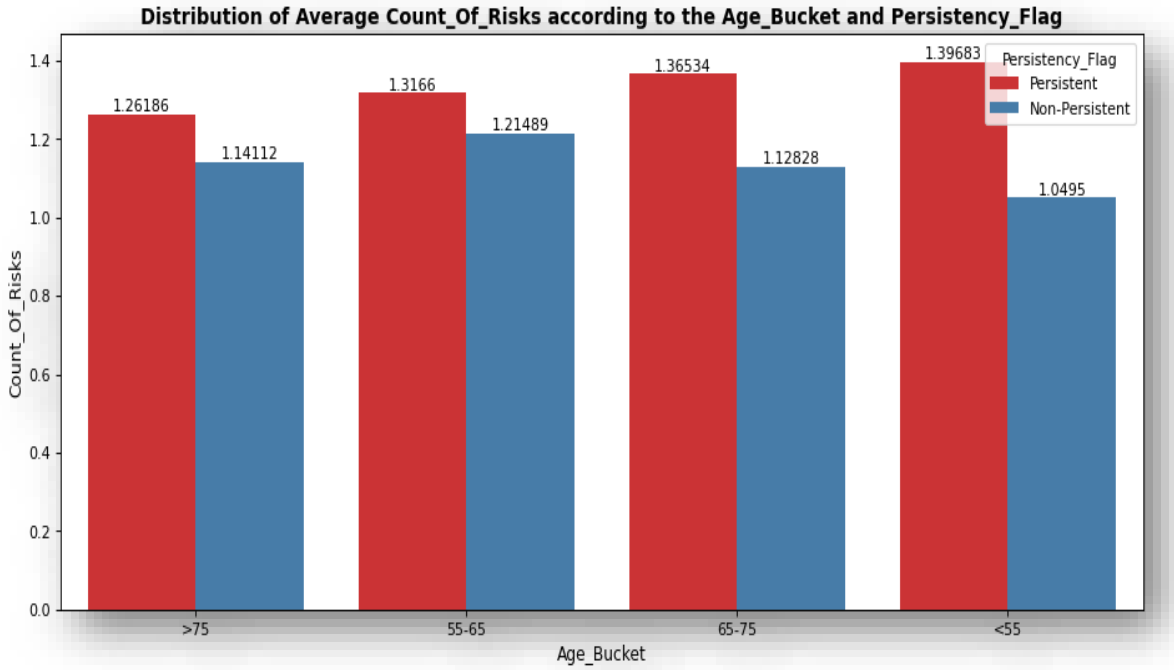
Analysis of average Count_Of_Risks, Dexa_Freq_During_Rx according to the Gender, Age Bucket and Persistency_Flag

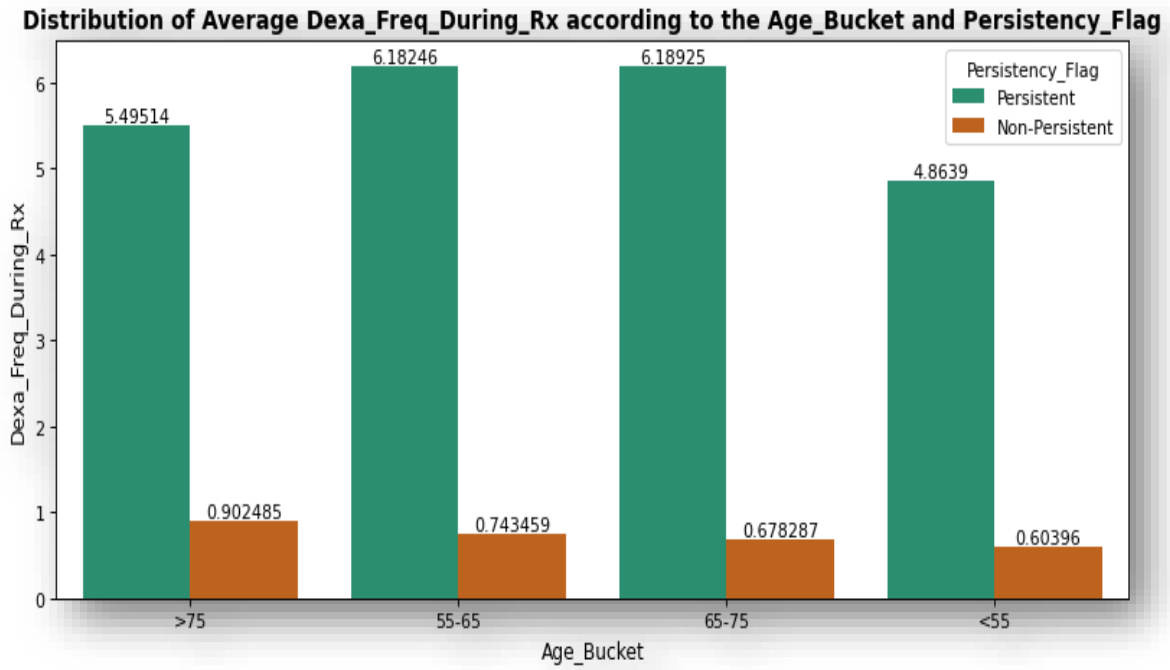
Gender





Age Bucket





- The analysis represents the average distribution analysis of persistency with the gend er and age bucket during Dexa_Freq_During_Rx and Count_Of_Risks administration.

Some other Clinical and Provider Attributes Features Analysis according to the Persistency_Flag

Ntm_Specialist_Flag

Persistency_Flag Ntm_Specialist_Flag	Non-Persistent	Persistent
Others	0.681138	0.318862
Specialist	0.544023	0.455977

Ntm_Speciality_Bucket

Persistency_Flag Ntm_Speciality_Bucket	Non-Persistent	Persistent
Endo/Onc/Uro	0.463932	0.536068
OB/GYN/Others/PCP/Unknown	0.680191	0.319809
Rheum	0.621035	0.378965

- The normalized percentage distribution of the target variable with the NTM_Specialist_Flag and the NTM_Speciality_Bucket variables are analyzed above.

Persistency_Flag	Non-Persistent	Persistent
Adherent_Flag		
Adherent	0.637349	0.362651
Non-Adherent	0.389535	0.610465

Persistency_Flag	Non-Persistent	Persistent
Risk_Chronic_Liver_Disease		
0	0.625702	0.374298
1	0.437500	0.562500

Persistency_Flag	Non-Persistent	Persistent
Risk_Excessive_Thinness		
0	0.622342	0.377658
1	0.758065	0.241935

Persistency_Flag	Non-Persistent	Persistent
Risk_Estrogen_Deficiency		
0	0.6243	0.3757
1	0.8000	0.2000

Persistency_Flag	Non-Persistent	Persistent
Risk_Type_1_Insulin_Dependent_Diabetes		
0	0.622861	0.377139
1	0.674419	0.325581

Persistency_Flag	Non-Persistent	Persistent
Risk_Smoking_Tobacco		
0	0.646698	0.353302
1	0.528571	0.471429

Models Recommendations

- **Logistic Regression**: A type of linear model used for binary classification. So, whether it belongs to one of the classes or is either a 0 or a 1. It attempts to predict the output value when given several input variables, placing the example into the correct category.
- **Decision Tree**: It builds classification or regression models in the form of a tree structure. It breaks down a dataset into smaller and smaller subsets while, at the same time, an associated decision tree is incrementally developed.
- **Random Forest**: It builds decision trees on different samples and takes their majority vote for classification and average in the case of regression.
- **XGBoost Classifier**: It is an implementation of gradient boosted decision trees designed for speed and performance in competitive machine learning. XGboost is an ensemble learning algorithm, meaning that it combines the results of many models.
- **AdaBoost Classifier**: It is used as an ensemble method. The most common estimator used with AdaBoost is decision trees with one level, which means decision trees with only one split.

Thank You

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