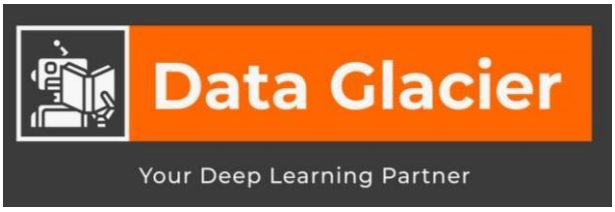
Data Science HealthCare Project

Drug Persistance



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Problem description

ABC Pharma is looking for an automated way better than the traditional debilitating methods currently used to assess persistence of drugs as per the physician prescription, in order to have a deeper understanding on the factors impacting the persistence of their drug. The aim is to know if a patient, based on his/her information, will follow the prescription of the physician and continue taking the drug for all the treatment time. We have been provided with a dataset which contains patients' details.

Business understanding

We will create a classification model as a solution that divides patients into categories depending on their information, to determine if a patient was persistent or not.

Our goal is to create a web application that might be used as an automated solution to this process of identification.

Data understanding

To fit any predictive model on a dataset, we need to understand the complexity of the dataset before deciding which predictive model to use to get optimal performance.

```
data.head()
```

	Persistency_Flag	Gender	Race	Ethnicity	Region	Age_Bucket	Ntm_Speciality	Ntm_Specialist_Flag	Ntm_Speciality_Bucket	Gluco_Record_Prior_Ntm	...
0	Persistent	Male	Caucasian	Not Hispanic	West	>75	GENERAL PRACTITIONER	Others	OB/GYN/Others/PCP/Unknown	N	...
1	Non-Persistent	Male	Asian	Not Hispanic	West	55-65	GENERAL PRACTITIONER	Others	OB/GYN/Others/PCP/Unknown	N	...
2	Non-Persistent	Female	Other/Unknown	Hispanic	Midwest	65-75	GENERAL PRACTITIONER	Others	OB/GYN/Others/PCP/Unknown	N	...
3	Non-Persistent	Female	Caucasian	Not Hispanic	Midwest	>75	GENERAL PRACTITIONER	Others	OB/GYN/Others/PCP/Unknown	N	...
4	Non-Persistent	Female	Caucasian	Not Hispanic	Midwest	>75	GENERAL PRACTITIONER	Others	OB/GYN/Others/PCP/Unknown	Y	...

5 rows × 68 columns

Type of data

```
[ ] data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3424 entries, 0 to 3423
Data columns (total 68 columns):
 #   Column                                                    Non-Null Count  Dtype 
---  ------                                                    --------------  ----- 
 0   Persistency_Flag                                          3424 non-null   object
 1   Gender                                                    3424 non-null   object
 2   Race                                                      3424 non-null   object
 3   Ethnicity                                                 3424 non-null   object
 4   Region                                                    3424 non-null   object
 5   Age_Bucket                                                3424 non-null   object
 6   Ntm_Speciality                                            3424 non-null   object
 7   Ntm_Specialist_Flag                                       3424 non-null   object
 8   Ntm_Speciality_Bucket                                     3424 non-null   object
 9   Gluco_Record_Prior_Ntm                                    3424 non-null   object
 10  Gluco_Record_During_Rx                                    3424 non-null   object
 11  Dexa_Freq_During_Rx                                       3424 non-null   int64 
 12  Dexa_During_Rx                                            3424 non-null   object
 13  Frag_Frac_Prior_Ntm                                       3424 non-null   object
 14  Frag_Frac_During_Rx                                       3424 non-null   object
 15  Risk_Segment_Prior_Ntm                                    3424 non-null   object
 16  Tscore_Bucket_Prior_Ntm                                   3424 non-null   object
 17  Risk_Segment_During_Rx                                    3424 non-null   object
 18  Tscore_Bucket_During_Rx                                   3424 non-null   object
 19  Change_T_Score                                            3424 non-null   object
 20  Change_Risk_Segment                                       3424 non-null   object
 21  Adherent_Flag                                             3424 non-null   object
 22  Idn_Indicator                                             3424 non-null   object
 23  Injectable_Experience_During_Rx                           3424 non-null   object
 24  Comorb_Encounter_For_Screening_For_Malignant_Neoplasms    3424 non-null   object
 25  Comorb_Encounter_For_Immunization                         3424 non-null   object
 26  Comorb_Encntr_For_General_Exam_W_O_Complaint,_Susp_Or_Reprtd_Dx  3424 non-null   object
 27  Comorb Vitamin D Deficiency                               3424 non-null   object
```

```
35  Comorb_Osteoporosis_without_current_pathological_fracture          3424 non-null   object
36  Comorb_Personal_history_of_malignant_neoplasm                      3424 non-null   object
37  Comorb_Gastro_esophageal_reflux_disease                            3424 non-null   object
38  Concom_Cholesterol_And_Triglyceride_Regulating_Preparations        3424 non-null   object
39  Concom_Narcotics                                                   3424 non-null   object
40  Concom_Systemic_Corticosteroids_Plain                              3424 non-null   object
41  Concom_Anti_Depressants_And_Mood_Stabilisers                       3424 non-null   object
42  Concom_Fluoroquinolones                                            3424 non-null   object
43  Concom_Cephalosporins                                              3424 non-null   object
44  Concom_Macrolides_And_Similar_Types                                3424 non-null   object
45  Concom_Broad_Spectrum_Penicillins                                  3424 non-null   object
46  Concom_Anaesthetics_General                                        3424 non-null   object
47  Concom_Viral_Vaccines                                              3424 non-null   object
48  Risk_Type_1_Insulin_Dependent_Diabetes                             3424 non-null   object
49  Risk_Osteogenesis_Imperfecta                                       3424 non-null   object
50  Risk_Rheumatoid_Arthritis                                          3424 non-null   object
51  Risk_Untreated_Chronic_Hyperthyroidism                             3424 non-null   object
52  Risk_Untreated_Chronic_Hypogonadism                                3424 non-null   object
53  Risk_Untreated_Early_Menopause                                     3424 non-null   object
54  Risk_Patient_Parent_Fractured_Their_Hip                            3424 non-null   object
55  Risk_Smoking_Tobacco                                               3424 non-null   object
56  Risk_Chronic_Malnutrition_Or_Malabsorption                         3424 non-null   object
57  Risk_Chronic_Liver_Disease                                         3424 non-null   object
58  Risk_Family_History_Of_Osteoporosis                                3424 non-null   object
59  Risk_Low_Calcium_Intake                                            3424 non-null   object
60  Risk_Vitamin_D_Insufficiency                                       3424 non-null   object
61  Risk_Poor_Health_Frailty                                           3424 non-null   object
62  Risk_Excessive_Thinness                                            3424 non-null   object
63  Risk_Hysterectomy_Oophorectomy                                     3424 non-null   object
64  Risk_Estrogen_Deficiency                                           3424 non-null   object
65  Risk_Immobilization                                                3424 non-null   object
66  Risk_Recurring_Falls                                               3424 non-null   object
67  Count_Of_Risks                                                     3424 non-null   int64
dtypes: int64(2), object(66)
memory usage: 1.8+ MB
```

```
[ ]  data.describe()
```

	Dexa_Freq_During_Rx	Count_Of_Risks
count	3424.000000	3424.000000
mean	3.016063	1.239486
std	8.136545	1.094914
min	0.000000	0.000000
25%	0.000000	0.000000
50%	0.000000	1.000000
75%	3.000000	2.000000
max	146.000000	7.000000

Unique elements in each Column

```
print(data.columns.unique)
```

```
<bound method Index.unique of Index(['Persistency_Flag', 'Gender', 'Race', 'Ethnicity', 'Region',
       'Age_Bucket', 'Ntm_Speciality', 'Ntm_Specialist_Flag',
       'Ntm_Speciality_Bucket', 'Gluco_Record_Prior_Ntm',
       'Gluco_Record_During_Rx', 'Dexa_Freq_During_Rx', 'Dexa_During_Rx',
       'Frag_Frac_Prior_Ntm', 'Frag_Frac_During_Rx', 'Risk_Segment_Prior_Ntm',
       'Tscore_Bucket_Prior_Ntm', 'Risk_Segment_During_Rx',
       'Tscore_Bucket_During_Rx', 'Change_T_Score', 'Change_Risk_Segment',
       'Adherent_Flag', 'Idn_Indicator', 'Injectable_Experience_During_Rx',
       'Comorb_Encounter_For_Screening_For_Malignant_Neoplasms',
       'Comorb_Encounter_For_Immunization',
       'Comorb_Encntr_For_General_Exam_W_O_Complaint,_Susp_Or_Reprtd_Dx',
       'Comorb_Vitamin_D_Deficiency',
       'Comorb_Other_Joint_Disorder_Not_Elsewhere_Classified',
       'Comorb_Encntr_For_Oth_Sp_Exam_W_O_Complaint_Suspected_Or_Reprtd_Dx',
       'Comorb_Long_Term_Current_Drug_Therapy', 'Comorb_Dorsalgia',
       'Comorb_Personal_History_Of_Other_Diseases_And_Conditions',
       'Comorb_Other_Disorders_Of_Bone_Density_And_Structure',
       'Comorb_Disorders_of_lipoprotein_metabolism_and_other_lipidemias',
       'Comorb_Osteoporosis_without_current_pathological_fracture',
       'Comorb_Personal_history_of_malignant_neoplasm',
       'Comorb_Gastro_esophageal_reflux_disease',
       'Concom_Cholesterol_And_Triglyceride_Regulating_Preparations',
       'Concom_Narcotics', 'Concom_Systemic_Corticosteroids_Plain',
       'Concom_Anti_Depressants_And_Mood_Stabilisers',
       'Concom_Fluoroquinolones', 'Concom_Cephalosporins',
       'Concom_Macrolides_And_Similar_Types',
       'Concom_Broad_Spectrum_Penicillins', 'Concom_Anaesthetics_General',
       'Concom_Viral_Vaccines', 'Risk_Type_1_Insulin_Dependent_Diabetes',
       'Risk_Osteogenesis_Imperfecta', 'Risk_Rheumatoid_Arthritis',
       'Risk_Untreated_Chronic_Hyperthyroidism',
       'Risk_Untreated_Chronic_Hypogonadism', 'Risk_Untreated_Early_Menopause',
       'Risk_Patient_Parent_Fractured_Their_Hip', 'Risk_Smoking_Tobacco',
       'Risk_Chronic_Malnutrition_Or_Malabsorption',
       'Risk_Chronic_Liver_Disease', 'Risk_Family_History_Of_Osteoporosis',
       'Risk_Low_Calcium_Intake', 'Risk_Vitamin_D_Insufficiency',
       'Risk_Poor_Health_Frailty', 'Risk_Excessive_Thinness',
       'Risk_Hysterectomy_Oophorectomy', 'Risk_Estrogen_Deficiency',
       'Risk_Immobilization', 'Risk_Recurring_Falls', 'Count_Of_Risks'],
      dtype='object')>
```

Data Problems

Data problems such as irrelevant columns, Null values, duplicates, skewed data, outliers and many others may cause bad predictions …

So we need to check if we have one of them to know then how to overcome it .

- **Skewed Data :**

```
[497] def measure_skew_kurtosis(cols):
          for col in cols:
              print(col)
              result = data[[col]].agg(['skew', 'kurtosis']).transpose()
              print(result)
      measure_skew_kurtosis(numeric_col)
```

```
Dexa_Freq_During_Rx
                          skew   kurtosis
Dexa_Freq_During_Rx  6.80873  74.758378
Count_Of_Risks
                     skew  kurtosis
Count_Of_Risks  0.879791  0.900486
```

```
[498] #skew and kurtosis values
      data.agg(['skew', 'kurtosis']).transpose()
```

	skew	kurtosis
Dexa_Freq_During_Rx	6.808730	74.758378
Count_Of_Risks	0.879791	0.900486

- **Outliers**

```
# creating a box plot of numerical columns against persitency flag to identify outliers
def boxplot(data, cols):
    for col in cols:
        sns.set_style('whitegrid')
        sns.boxplot(x='Persistency_Flag', y=col, data=data)
        plt.title('Boxplot of ' + col)
        plt.ylabel(col) #setting text for y axis
        plt.show()
boxplot(data, numeric_col)
```

- **Duplicates**

⇨ **There is no duplicates , Having duplicates leads often to overfitting**

- **Missing Values**

```
[ ]  # Total number of missing values
     data.isnull().sum().sum()

     0
```

⇨ **No missing Values**

Solutions

- **Removing duplicates if they exists**
- **Dropping unsignificant columns**
- **Eliminating Skewed data**

```
[501] #Checking skew after transformation
      data.agg(['skew', 'kurtosis']).transpose()
```

	skew	kurtosis
Dexa_Freq_During_Rx	6.808730	74.758378
Count_Of_Risks	0.879791	0.900486
log_Dexa	1.405860	0.624570
log_Count_Risks	-0.091583	-1.006414

Example of removing 99% Percentile

```
[505] # To remove the 99th percentile
      q = data['Dexa_Freq_During_Rx'].quantile(0.99)
      data_1 = data[data['Dexa_Freq_During_Rx']<q]
      data_1.describe()
```

	Dexa_Freq_During_Rx	Count_Of_Risks	log_Dexa	log_Count_Risks
count	3389.000000	3389.000000	3389.000000	3389.000000
mean	2.440248	1.240484	0.572915	0.685941
std	5.183446	1.095904	0.997375	0.499826
min	0.000000	0.000000	0.000000	0.000000
25%	0.000000	0.000000	0.000000	0.000000
50%	0.000000	1.000000	0.000000	0.693147
75%	3.000000	2.000000	1.386294	1.098612
max	34.000000	7.000000	3.555348	2.079442

- **Removing outliers**