WEEK 10 Deliverables
Data Glacier Team: The Data Dynamos
Batch Code: `LISUM04`
Remote Internship Cohort: September to December 2021
This report is submitted as a text link to Canvas

1. Team member's details:

Jennifer Turley
Jennifer.turley@ucdconnect.ie
Ph +353 83 065 7252
University College Dublin, Ireland
Data Science

Queen Echerenwa
Quin_codes@outlooks.com
+234 806 352 8847
Data Science

Ateeb Aqil Aziz
Atteeb.aqil@gmail.com
Ph +92 3044693262
Data Science

Github repo link:

The code and corresponding Jupyter notebook printout PDF can be found at
https://github.com/DataDynamosTeam/DrugPersistencyProject/tree/JTs-branch

Note the code is identified with leading characters W10

Problem Description:

Drug persistency with a medical treatment is the continuation by the patient of a treatment prescribed by a medical provider. When a patient fails to be *persistent* (by quitting the treatment prematurely) this can be expected to have a negative impact on the medical outcome for that patient. This project examines drug persistency for a treatment for improving bone density, with the goal to understanding and clarifying variables that have an impact on persistency.

Utilizing a dataset of 3434 observations of primarily categorical data, the data is first cleaned and transformed to numerical formats. Then classification models from Scikit-learn, Imbalanced-learn, and Statsmodels are applied in an effort to predict drug persistency from the other variables provided.

Exploratory Data Analysis (EDA) Performed on the Data:

The data cleansing and transformation accomplished in Weeks 8 and 9 included correcting some miscoded names (cleansing) and conversion of categorical values to numerical formats (transformation). Some new variables were created from old variables. Bar charts of individual variables against the Persistency_Flag variable were also created. These bar charts visually demonstrated which independent variables might contribute to the prediction of the persistency. These charts are included in the Week 8 .ipynb Jupyter notebook.

Preliminary models were run which in combination with the bar charts permitted the creation of a reduced list of features of interest for predicting persistency.

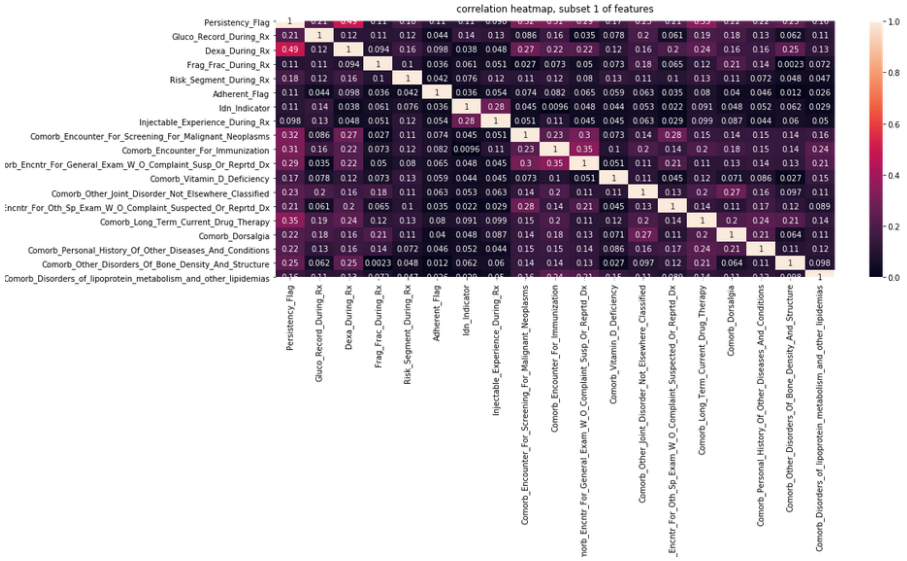
This reduced list is as follows:

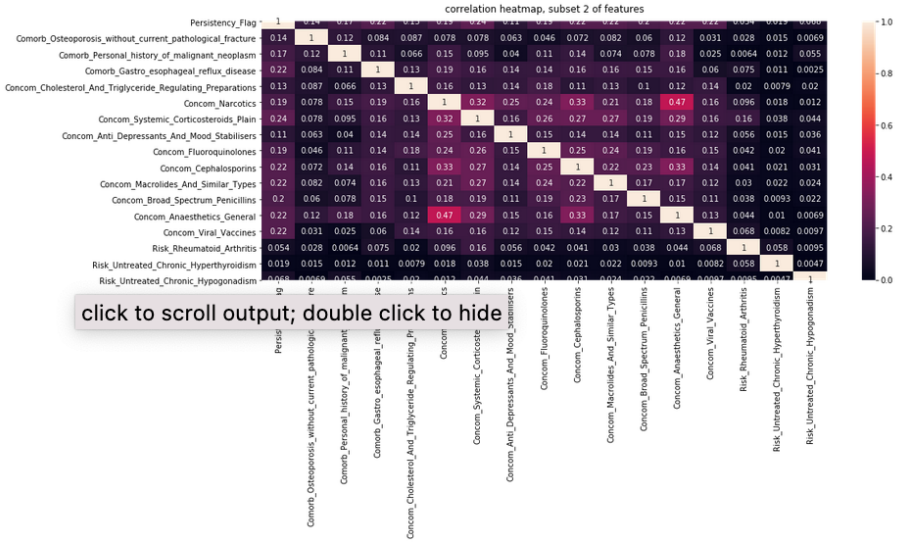
```
features = ['Gluco_Record_During_Rx', 'Dexa_During_Rx', 'Frag_Frac_During_Rx', 'Risk_Segment_During_Rx', 'Adherent_Flag', 'Idn_Indicator',
            'Injectable_Experience_During_Rx', 'Comorb_Encounter_For_Screening_For_Malignant_Neoplasms', 'Comorb_Encounter_For_Immunization',
            'Comorb_Encntr_For_General_Exam_W_O_Complaint_Susp_Or_Reprtd_Dx', '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_Rheumatoid_Arthritis', 'Risk_Untreated_Chronic_Hyperthyroidism', 'Risk_Untreated_Chronic_Hypogonadism',
            'Risk_Smoking_Tobacco', 'Risk_Chronic_Malnutrition_Or_Malabsorption', 'Risk_Chronic_Liver_Disease',  'Risk_Low_Calcium_Intake',
            'Risk_Vitamin_D_Insufficiency', 'Risk_Poor_Health_Frailty', 'Risk_Excessive_Thinness', 'Risk_Estrogen_Deficiency', 'Risk_Immobilization',
            'Dexa_Freq_During_Rx_Bucket_Flag','Change_RiskSeg_Worsened','Change_RiskSeg_Improved', 'Change_RiskSeg_Unk' , 'ChangedTScore_Worsened',
            'ChangedTScore_Improved', 'ChangedTScore_Unk', 'AsianRace_Flag',  'Midwest_Flag', 'Ntm_Speciality_MyBuckets1', 'Ntm_Speciality_MyBuckets2' ]
```

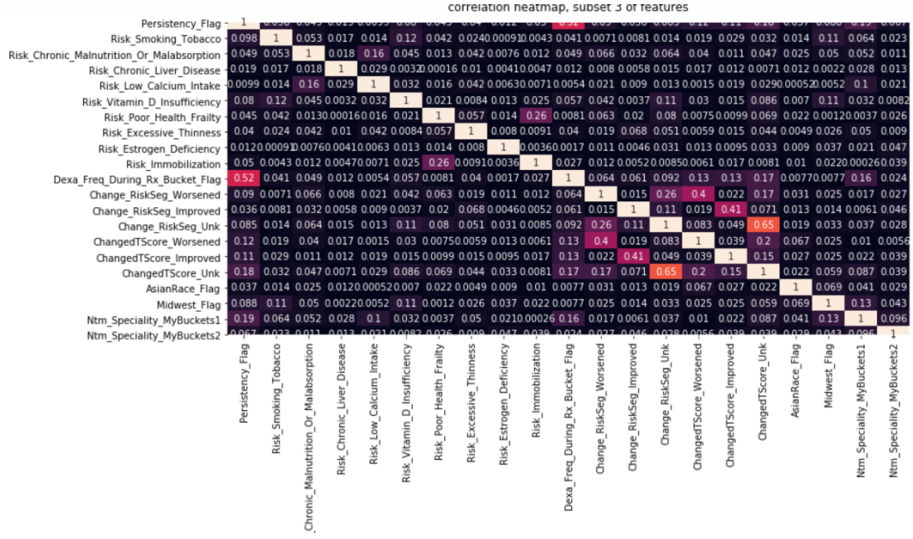
Since using predictor variables that are themselves correlated (with each other) is a potential problem when applying models that assume these predictors are linearly independent (such as in logistic regression), it was important to examine potential correlations between the proposed predictor variables. One correlation table was produced for all the independent variables: this allowed for checking the level of correlation between all of the independent variables. Since many variables were already eliminated in Week 9, including those with different codings of the same information (such as for speciality of the prescribing doctor – given individually and also in buckets), there was no excessive correlation between the remaining list of features to be used as predictors.

Next, correlation heatmaps were created, with the features list split into three smaller sets for ease of viewing the resulting charts (to prevent excessively small squares). The Persistency_Flag variable was included in the heatmaps since it is of value to visualize its correlation which the predictor variables, although the correlation has already been assessed numerically in Week 9.

The heatmaps are shown below:


correlation heatmap, subset 1 of features
Persistency_Flag
Gluco_Record_During_Rx
Dexa_During_Rx
Frag_Frac_During_Rx
Risk_Segment_During_Rx
Adherent_Flag
Idn_Indicator
Injectable_Experience_During_Rx
Comorb_Encounter_For_Screening_For_Malignant_Neoplasms
Comorb_Encounter_For_Immunization
Comorb_Encounter_For_General_Exam_W_O_Complaint_Susp_Or_Reprtd_Dx
Comorb_Vitamin_D_Deficiency
Comorb_Other_Joint_Disorder_Not_Elsewhere_Classified
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


correlation heatmap, subset 2 of features
Persistency_Flag
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_Rheumatoid_Arthritis
Risk_Untreated_Chronic_Hyperthyroidism
Risk_Untreated_Chronic_Hypogonadism
click to scroll output; double click to hide


correlation heatmap, subset 3 of features
Persistency_Flag
Risk_Smoking_Tobacco
Risk_Chronic_Malnutrition_Or_Malabsorption
Risk_Chronic_Liver_Disease
Risk_Low_Calcium_Intake
Risk_Vitamin_D_Insufficiency
Risk_Poor_Health_Frailty
Risk_Excessive_Thinness
Risk_Estrogen_Deficiency
Risk_Immobilization
Dexa_Freq_During_Rx_Bucket_Flag
Change_RiskSeg_Worsened
Change_RiskSeg_Improved
Change_RiskSeg_Unk
ChangedTScore_Worsened
ChangedTScore_Improved
ChangedTScore_Unk
AsianRace_Flag
Midwest_Flag
Ntm_Speciality_MyBuckets1
Ntm_Speciality_MyBuckets2

Final Recommendation:

The models that performed most successfully for classification of drug persistency were models taking into account the imbalanced quality of the data. By using the Balanced Bagging or the Balanced Random Forest Classifier, both from imblearn.ensemble, the classification accuracy and ROC AUC achieved were in the mid-90s, as compared to values for accuracy in the low 80s with the other methods that do not compensate for imbalance in the target variable. Further information on these results will be provided in the following weeks' deliverables.