Random Forest Regressor-Medical Data Set

Analysis Goals:

Predict the number of days a patient stays in the hospital ("initial_days") utilizing the gathered data.

In [8]:

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

In [9]:

```
df= pd.read_csv('C:/Users/cynth/OneDrive/Documents/MS Data Analytics/Cleaned_Medical_Da
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9120 entries, 0 to 9119
Data columns (total 50 columns):
 #   Column                                Non-Null Count  Dtype  
---  ------                                --------------  -----  
 0   Unnamed: 0                            9120 non-null   int64  
 1   Lat                                   9120 non-null   float64
 2   Lng                                   9120 non-null   float64
 3   Population                            9120 non-null   int64  
 4   Children                              9120 non-null   int64  
 5   Age                                   9120 non-null   int64  
 6   Income                                9120 non-null   float64
 7   ReAdmis                               9120 non-null   int64  
 8   VitD_levels                           9120 non-null   float64
 9   Doc_visits                            9120 non-null   int64  
 10  Full_meals_eaten                      9120 non-null   int64  
 11  vitD_supp                             9120 non-null   int64  
 12  Soft_drink                            9120 non-null   int64  
 13  HighBlood                             9120 non-null   int64  
 14  Stroke                                9120 non-null   int64  
 15  Overweight                            9120 non-null   int64  
 16  Arthritis                             9120 non-null   int64  
 17  Diabetes                              9120 non-null   int64  
 18  Hyperlipidemia                        9120 non-null   int64  
 19  BackPain                              9120 non-null   int64  
 20  Anxiety                               9120 non-null   int64  
 21  Allergic_rhinitis                     9120 non-null   int64  
 22  Reflux_esophagitis                    9120 non-null   int64  
 23  Asthma                                9120 non-null   int64  
 24  Initial_days                          9120 non-null   float64
 25  TotalCharge                           9120 non-null   float64
 26  Additional_charges                    9120 non-null   float64
 27  Item1                                 9120 non-null   int64  
 28  Item2                                 9120 non-null   int64  
 29  Item3                                 9120 non-null   int64  
 30  Item4                                 9120 non-null   int64  
 31  Item5                                 9120 non-null   int64  
 32  Item6                                 9120 non-null   int64  
 33  Item7                                 9120 non-null   int64  
 34  Item8                                 9120 non-null   int64  
 35  Area_Suburban                         9120 non-null   int64  
 36  Area_Rural                            9120 non-null   int64  
 37  Marital_Married                       9120 non-null   int64  
 38  Marital_Separated                     9120 non-null   int64  
 39  Marital_Never Married                9120 non-null   int64
 40  Marital_Divorced                     9120 non-null   int64
 41  Gender_Female                        9120 non-null   int64
 42  Gender_Nonbinary                     9120 non-null   int64
 43  Initial_admin_Elective Admission     9120 non-null   int64
 44  Initial_admin_Observation Admission  9120 non-null   int64
 45  Complication_risk_High               9120 non-null   int64
 46  Complication_risk_Low                9120 non-null   int64
 47  Services_Intravenous                 9120 non-null   int64
 48  Services_CT Scan                     9120 non-null   int64
 49  Services_MRI                         9120 non-null   int64
dtypes: float64(7), int64(43)
memory usage: 3.5 MB
```

Random Forest Regressor

In [10]:

```python
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error as MSE
from sklearn.model_selection import cross_val_score

X = df.drop(['Initial_days'], axis=1)
y = df['Initial_days']
```

In [11]:

```python
#Split the data into training and test data sets.
X_train, X_test, y_train, y_test= train_test_split(X, y, test_size=0.3, random_state= 4
X_train.to_csv("D209Task2_X_train.csv")
X_test.to_csv("D209Task2_X_test.csv")
y_train.to_csv("D209Task2_y_train.csv")
y_test.to_csv("D209Task2_y_test.csv")
```

In [12]:

```python
#instantiate Random Forest Regressor
rf = RandomForestRegressor(max_depth = 6)
#train the model
rf.fit(X_train, y_train)
#predict labels for X_test
cv=cross_val_score(rf,X_train, y_train,scoring='r2',  cv=5 )
cv_mean = np.mean(cv)
cv_test=cross_val_score(rf,X_test, y_test,scoring='r2',  cv=5 )
cv_test_mean = np.mean(cv_test)
y_pred=rf.predict(X_test)
# Evaluate
mse = MSE(y_test, y_pred)
rmse=(mse**(1/2))
print('Test set MSE of rf: {:.4f}'.format(mse))
print('Test set RMSE of rf: {:.4f}'.format(rmse))
print( 'Cross Val Score R2 for train data: {:.4f}'.format(cv_mean))
print( 'Cross Val Score R2 for test data: {:.4f}'.format(cv_test_mean))
print('rf train score: ', rf.score(X_train, y_train))
print('rf test score', rf.score(X_test, y_test))
```

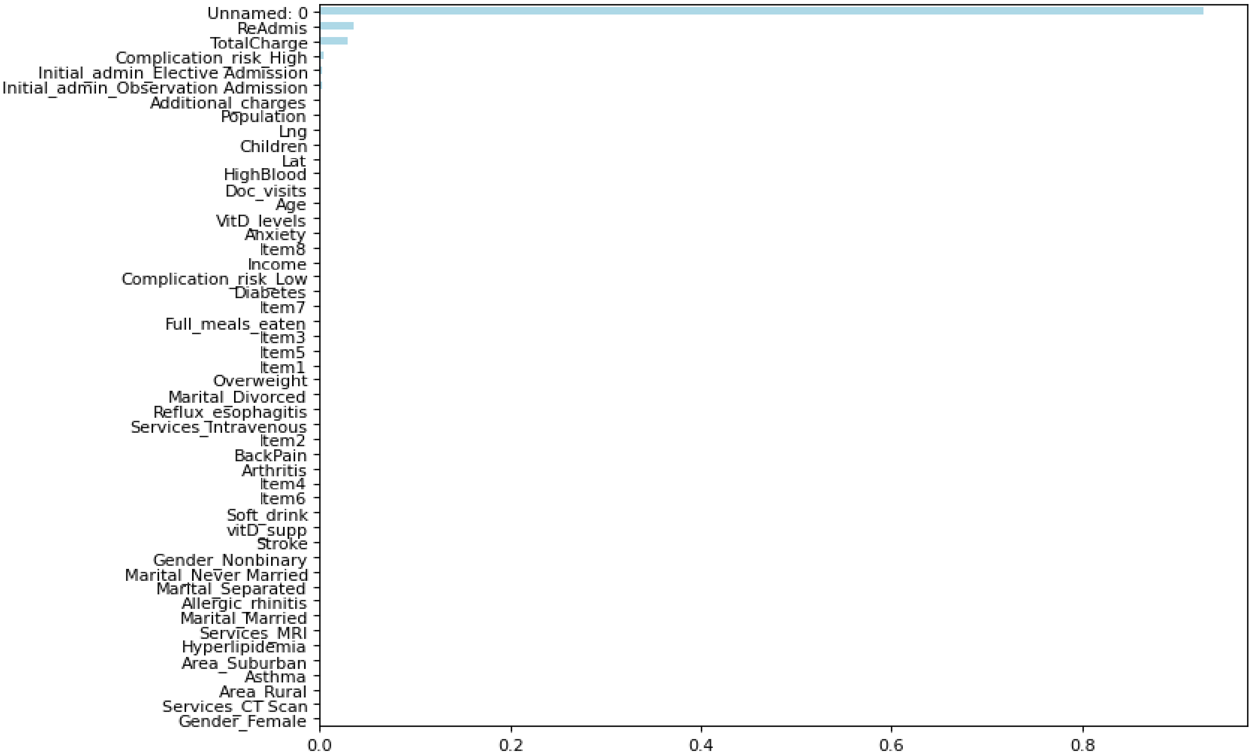
```
Test set MSE of rf: 4.6822
Test set RMSE of rf: 2.1639
Cross Val Score R2 for train data: 0.9928
Cross Val Score R2 for test data: 0.9926
rf train score:  0.9936514742989756
rf test score 0.9931976076328076
```

In [13]:

```
#feature importance for rf tree
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.pyplot import figure

figure(figsize=(10, 8), dpi=80)
#create a pd.series of feature importance
importances_rf = pd.Series(rf.feature_importances_, index=X.columns)
# sort importances_rf =
sorted_importances_rf =importances_rf.sort_values()
#make horizontal bar plot
sorted_importances_rf.plot(kind='barh', color='lightblue')

plt.show()
```

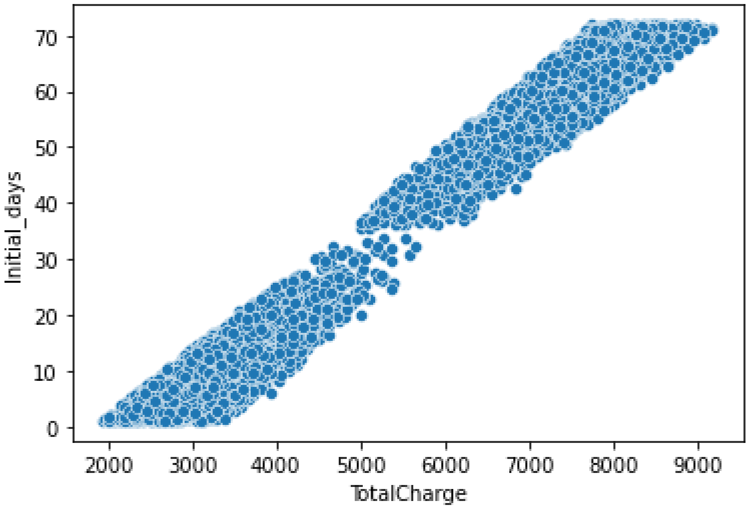


In [14]:

```
sns.scatterplot(x=df.TotalCharge, y=df.Initial_days)
```

Out[14]:

```
<AxesSubplot:xlabel='TotalCharge', ylabel='Initial_days'>
```



Data Summary and Implications

1. Acccuracy and the mean squared error (MSE) of the prediction model.

The following metrics were calculated for this random forest classifier. As shown below, the MSE is 4.9706, the R2 of both the training and test data was 0.99, and the scores for the random forest model are also 0.99. This all seems to indicate that this model does a good job of predicting inital_days.

```
Test set MSE of rf: 4.9706
Test set RMSE of rf: 2.2295
Cross Val Score R2 for train data: 0.9928
Cross Val Score R2 for test data: 0.9926
rf train score:  0.9935368952029457
rf test score 0.9927787420296704
```

2. Implications of the prediction analysis.

The MSE, RMSE, R2, and model score seem to indicate that the random forest regressor is highly accurate and can be used to help predict the initial days in a visit.

3. Limitations of the data analysis.

One limitation of my analysis is that I did not utilize a grid search to tune the hyperparameters for my random forest regressor and I used the default number of regression trees. Its possible that tuning these hyperparameters and increading the number of trees could make the model better, but since it is already so accurate, it probably wouldn't make much of a differnce in terms of helping the client predict initial days.

4. Recommended course of action

As noted in the feature importance plot, one variable , total charge, is almost a perfect fit for initial days. My next steps would be to remove this variable to compare the accuracy and then check in with the client to hear their thoughts. Otherwise, would Since the random forest regressor seems to be highly accurate, I would suggest that the organization can proceed and continue to run the model to predict new data. If the accuracy of the model drops significantly then we could re-train the data and experiment with voting classifiers or decision trees with bootsting.