Chapter 7 - Exercise 2: Absenteeism_at_work

Cho dữ liệu Absenteeism_at_work trong tập tin Absenteeism_at_work.csv

Yêu cầu: Hãy đọc dữ liệu từ tập tin này, áp dụng Random Forest để thực hiện việc xác định thời gian vắng mặt theo giờ (Absenteeism time in hours (target)) dựa trên các thông tin được cung cấp.

Chi tiết:

1. Đọc dữ liệu. Chuẩn hóa dữ liệu
2. Tạo X_train, X_test, y_train, y_test từ dữ liệu chuẩn hóa với tỷ lệ dữ liệu test là 0.3
3. Áp dụng Random Forest, Tìm kết quả
4. Kiểm tra độ chính xác
5. Tìm các thuộc tính quan trọng nhất trong tập dữ liệu
6. Trực quan hóa thuộc tính quan trọng
7. Áp dụng lại Random Forest dựa trên các thuộc tính quan trọng, tìm kết quả
8. Kiểm tra độ chính xác
9. Tự cho 1 dữ liệu X_test mới. Ví dụ như: ['Reason for absence', 'Work load Average per day', 'Age',

   ```
   'Month of absence', 'Day of the week', 'Hit target',
   'Transportation expense', 'Weight', 'Seasons', 'Height',
   'Distance from Residence to Work', 'Son', 'Pet', 'Service time'] ứng
   với [ 10., 205.917, 28.,8., 4., 92., 330. ,
    84., 1., 182., 16., 0., 0., 4.]. Tìm kết quả Y test.
   ```

Attribute Information:

1. Individual identification (ID)
2. Reason for absence (ICD). Absences attested by the International Code of Diseases (ICD) stratified into 21 categories (I to XXI) as follows:
3. I Certain infectious and parasitic diseases
4. II Neoplasms
5. III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
6. IV Endocrine, nutritional and metabolic diseases
7. V Mental and behavioural disorders
8. VI Diseases of the nervous system
9. VII Diseases of the eye and adnexa
10. VIII Diseases of the ear and mastoid process
11. IX Diseases of the circulatory system

12. X Diseases of the respiratory system
13. XI Diseases of the digestive system
14. XII Diseases of the skin and subcutaneous tissue
15. XIII Diseases of the musculoskeletal system and connective tissue
16. XIV Diseases of the genitourinary system
17. XV Pregnancy, childbirth and the puerperium
18. XVI Certain conditions originating in the perinatal period
19. XVII Congenital malformations, deformations and chromosomal abnormalities
20. XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
21. XIX Injury, poisoning and certain other consequences of external causes
22. XX External causes of morbidity and mortality
23. XXI Factors influencing health status and contact with health services.

And 7 categories without (CID) patient follow-up (22), medical consultation (23), blood donation (24), laboratory examination (25), unjustified absence (26), physiotherapy (27), dental consultation (28).

3. Month of absence
4. Day of the week (Monday (2), Tuesday (3), Wednesday (4), Thursday (5), Friday (6))
5. Seasons (summer (1), autumn (2), winter (3), spring (4))
6. Transportation expense
7. Distance from Residence to Work (kilometers)
8. Service time
9. Age
10. Work load Average/day
11. Hit target
12. Disciplinary failure (yes=1; no=0)
13. Education (high school (1), graduate (2), postgraduate (3), master and doctor (4))
14. Son (number of children)
15. Social drinker (yes=1; no=0)
16. Social smoker (yes=1; no=0)
17. Pet (number of pet)
18. Weight
19. Height
20. Body mass index
21. Absenteeism time in hours (target)

In [1]:

```
# from google.colab import drive
# drive.mount("/content/gdrive", force_remount=True)
# %cd '/content/gdrive/My Drive/LDS6_MachineLearning/practice/Chapter7_Random_Fo
```

In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
import math
```

In [3]:

```
data = pd.read_csv("Absenteeism_at_work.csv", sep=";")
```

In [4]:
```
type(data)
```

Out[4]:
```
pandas.core.frame.DataFrame
```

In [5]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 740 entries, 0 to 739
Data columns (total 21 columns):
ID                                 740 non-null int64
Reason for absence                 740 non-null int64
Month of absence                   740 non-null int64
Day of the week                    740 non-null int64
Seasons                            740 non-null int64
Transportation expense             740 non-null int64
Distance from Residence to Work    740 non-null int64
Service time                       740 non-null int64
Age                                740 non-null int64
Work load Average per day          740 non-null float64
Hit target                         740 non-null int64
Disciplinary failure               740 non-null int64
Education                          740 non-null int64
Son                                740 non-null int64
Social drinker                     740 non-null int64
Social smoker                      740 non-null int64
Pet                                740 non-null int64
Weight                             740 non-null int64
Height                             740 non-null int64
Body mass index                    740 non-null int64
Absenteeism time in hours          740 non-null int64
dtypes: float64(1), int64(20)
memory usage: 121.5 KB
```

In [6]:
```
data.head()
```

Out[6]:

	ID	Reason for absence	Month of absence	Day of the week	Seasons	Transportation expense	Distance from Residence to Work	Service time	Age	Work load Average per day	...
0	11	26	7	3	1	289	36	13	33	239.554	...
1	36	0	7	3	1	118	13	18	50	239.554	...
2	3	23	7	4	1	179	51	18	38	239.554	...
3	7	7	7	5	1	279	5	14	39	239.554	...
4	11	23	7	5	1	289	36	13	33	239.554	...

5 rows × 21 columns

In [7]:
```
data.tail()
```

Out[7]:

	ID	Reason for absence	Month of absence	Day of the week	Seasons	Transportation expense	Distance from Residence to Work	Service time	Age	Work load Average per day	...
735	11	14	7	3	1	289	36	13	33	264.604	...
736	1	11	7	3	1	235	11	14	37	264.604	...
737	4	0	0	3	1	118	14	13	40	271.219	...
738	8	0	0	4	2	231	35	14	39	271.219	...
739	35	0	0	6	3	179	45	14	53	271.219	...

5 rows × 21 columns

In [8]:
```
X = data.iloc[:, 1:-1]
y = data.iloc[:,-1]
```

In [9]:
```
X.head()
```

Out[9]:

	Reason for absence	Month of absence	Day of the week	Seasons	Transportation expense	Distance from Residence to Work	Service time	Age	Work load Average per day	Hit target	I
0	26	7	3	1	289	36	13	33	239.554	97	
1	0	7	3	1	118	13	18	50	239.554	97	
2	23	7	4	1	179	51	18	38	239.554	97	
3	7	7	5	1	279	5	14	39	239.554	97	
4	23	7	5	1	289	36	13	33	239.554	97	

In [10]:
```
y.head()
```

Out[10]:
```
0    4
1    0
2    2
3    4
4    2
Name: Absenteeism time in hours, dtype: int64
```

In [11]:
```
# Import train_test_split function
from sklearn.model_selection import train_test_split
# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(X, y,
                                                    test_size=0.3,
                                                    random_state = 1)
```

In [12]:

```
from sklearn.ensemble import RandomForestRegressor
```

In [13]:

```
clf=RandomForestRegressor(n_estimators=250)
```

In [14]:

```
clf.fit(X_train,y_train)
y_pred = clf.predict(X_test)
```

In [15]:

```
type(y_test)
```

Out[15]:

```
pandas.core.series.Series
```

In [16]:

```
type(y_pred)
```

Out[16]:

```
numpy.ndarray
```

In [17]:

```
from sklearn import metrics
print("Mean Squared Error:", metrics.mean_squared_error(y_test, y_pred))
```

```
Mean Squared Error: 135.82905460984801
```

In [18]:

```
# Evaluation
print("The R^2: ",clf.score(X,y)*100,"%")
print("The Training R^2 is: ",clf.score(X_train,y_train)*100,"%")
print("The Testing R^2 is: ",clf.score(X_test,y_test)*100,"%")
```

```
The R^2:  66.20062126745441 %
The Training R^2 is:  84.58017856035795 %
The Testing R^2 is:  22.68756626460451 %
```

In [19]:

```
# => The Training  R^2 >> Testing R^2 => Overfitting => Solution???
```

In [20]:

```
# Finding Important Features in Scikit-learn
import pandas as pd
feature_imp = pd.Series(clf.feature_importances_,
              index = np.array(X.columns)).sort_values(ascending=False)
feature_imp
```

Out[20]:

```
Reason for absence                   0.239709
Work load Average per day            0.159207
Age                                  0.101243
Month of absence                     0.072667
Day of the week                      0.062343
Hit target                           0.061113
Transportation expense               0.046585
Seasons                              0.043181
Height                               0.036873
Weight                               0.035640
Son                                  0.033851
Distance from Residence to Work      0.028690
Body mass index                      0.021658
Pet                                  0.020293
Service time                         0.018473
Social drinker                       0.011183
Education                            0.002986
Social smoker                        0.002728
Disciplinary failure                 0.001578
dtype: float64
```

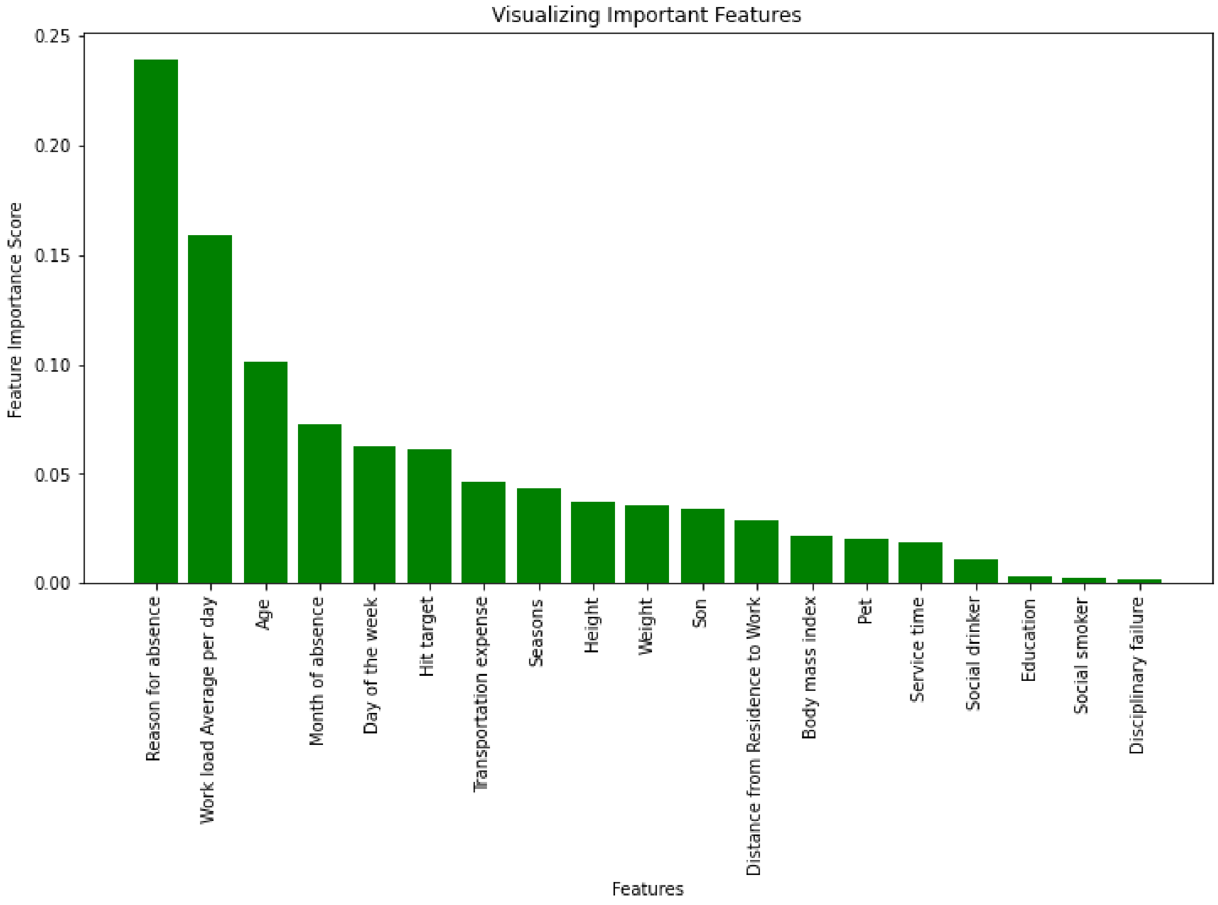
In [21]:

```
type(feature_imp)
```

Out[21]:

```
pandas.core.series.Series
```

In [22]:
```
import matplotlib.pyplot as plt
%matplotlib inline
# Creating a bar plot
plt.figure(figsize=(12,6))
plt.bar(feature_imp.index, feature_imp, color="g")
# Add labels to your graph
plt.xlabel('Features')
plt.ylabel('Feature Importance Score')
plt.title("Visualizing Important Features")
plt.xticks(rotation = "vertical")
plt.show()
```



In [23]:

```
feature_imp[feature_imp >0.05].sum()
```

Out[23]:

```
0.6962816478490609
```

In [24]:

```
feature_imp_select = feature_imp[feature_imp >0.05]
feature_imp_select
```

Out[24]:

```
Reason for absence            0.239709
Work load Average per day     0.159207
Age                           0.101243
Month of absence              0.072667
Day of the week               0.062343
Hit target                    0.061113
dtype: float64
```

In [25]:

```
feature_imp_select.index
```

Out[25]:

```
Index(['Reason for absence', 'Work load Average per day', 'Age',
       'Month of absence', 'Day of the week', 'Hit target'],
      dtype='object')
```

In [26]:

```
# Tạo lại dữ liệu huấn luyện và test sau khi bỏ đi các thuộc tính ít quan trọng
# Split dataset into features and labels
X1 = data[feature_imp_select.index]
y1 = data['Absenteeism time in hours']
```

In [27]:

```
# Split dataset into training set and test set
X1_train, X1_test, y1_train, y1_test = train_test_split(X1, y1,
                                                        test_size=0.3,
                                                        random_state = 1)
```

In [28]:

```
clf1=RandomForestRegressor(n_estimators=100)
clf1.fit(X1_train,y1_train)

y1_pred=clf1.predict(X1_test)
```

In [29]:

```
print("Mean Squared Error:", metrics.mean_squared_error(y1_test, y1_pred))
```

```
Mean Squared Error: 143.32988166691695
```

In [30]:
```
# Evaluation
print("The R^2: ",clf1.score(X1,y1)*100,"%")
print("The Training R^2: ",clf1.score(X1_train,y1_train)*100,"%")
print("The Testing R^2: ",clf1.score(X1_test,y1_test)*100,"%")
```

```
The R^2:  63.95827833298296 %
The Training R^2:  83.19396461515296 %
The Testing R^2:  18.41817635773949 %
```

In [31]:
```
# => The Training  R^2 >> Testing R^2 => Overfitting => Solution???
```

In [32]:
```
a = X1.iloc[20]
X_new = a.values
```

In [33]:
```
clf1.predict([X_new])
```

Out[33]:
```
array([18.31])
```