Dummy Variables & One Hot Encoding

Outlines

- Using pandas get_dummies
- Using sklearn OneHotEncod
- Excercise

Problem

Bhild a predictor function to predict price of a home,
1. With 3400 sqr ft area in west windsor
2. 2800 sqr ft home in robbinsville

How to handle text data?

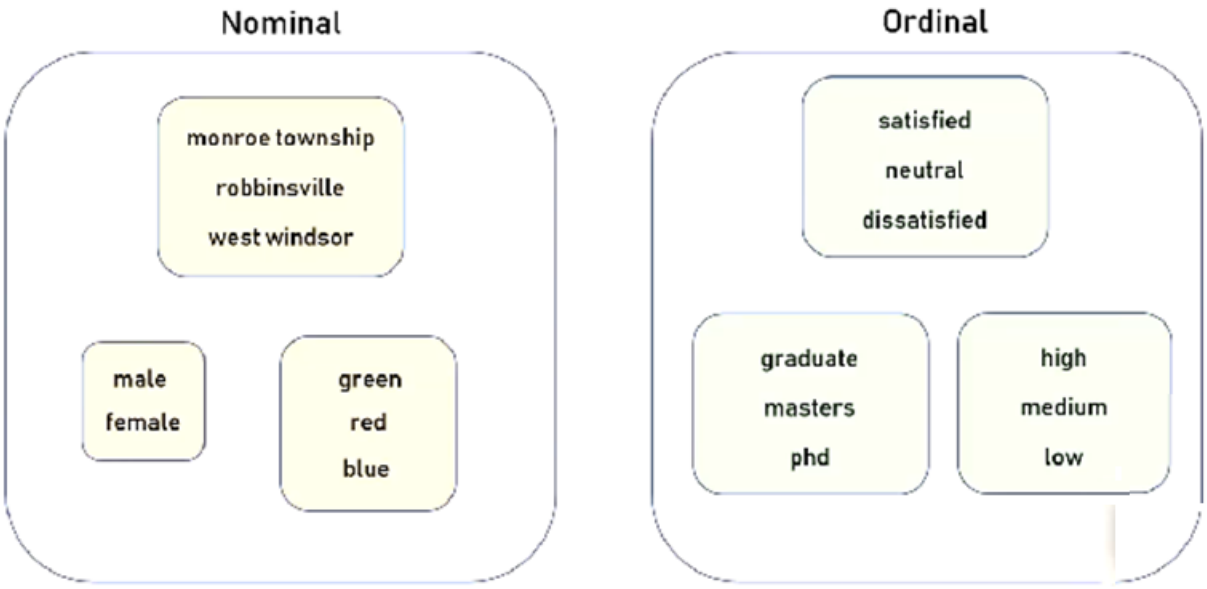
town	area	price
monroe township	2600	550000
monroe township	3000	565000
monroe township	3200	610000
monroe township	3600	680000
monroe township	4000	725000
west windsor	2600	585000
west windsor	2800	615000
west windsor	3300	650000
west windsor	3600	710000
robbinsville	2600	575000
robbinsville	2900	600000
robbinsville	3100	620000
robbinsville	3600	695000

One way to handle text data is labal encoding. In other words assign integets to text like this:
Monroe township = 1, West Windsor =2, Robbinsville =3
The problem with this approach is that it will assume
Monroe township < West Windsor < Robbinsville =3??
This isn't make sense.

Categorical Variables:

There are 2 types of categorical variables:

1. Nominal: The categories don't have any numeric order. such as male & female, colors, name of towns.
2. Ordinal: The categories have some numeric order. Such as degree, ...



One Hot Encoding

town	area	price	monroe township	west windsor	robbinsville
monroe township	2600	550000	1	0	0
monroe township	3000	565000	1	0	0
monroe township	3200	610000	1	0	0
monroe township	3600	680000	1	0	0
monroe township	4000	725000	1	0	0
west windsor	2600	585000	0	1	0
west windsor	2800	615000	0	1	0
west windsor	3300	650000	0	1	0
west windsor	3600	710000	0	1	0
robbinsville	2600	575000	0	0	1
robbinsville	2900	600000	0	0	1
robbinsville	3100	620000	0	0	1
robbinsville	3600	695000	0	0	1

The way One hot encoding works is you create a new column for each of your categories and assign binary value of 1 and 0.

In [1]:
```
import pandas as pd
```

In [2]:
```
df = pd.read_csv('D:/Data_Science/My Github/Machine-Learning-with-Python/5. One Ho
df
```

Out[2]:

	town	area	price
0	monroe township	2600	550000
1	monroe township	3000	565000
2	monroe township	3200	610000
3	monroe township	3600	680000
4	monroe township	4000	725000
5	west windsor	2600	585000
6	west windsor	2800	615000
7	west windsor	3300	650000
8	west windsor	3600	710000
9	robinsville	2600	575000
10	robinsville	2900	600000
11	robinsville	3100	620000
12	robinsville	3600	695000

In [3]:
```
# Create dummy variable columns
dummies = pd.get_dummies(df.town)
dummies
```

Out[3]:

	monroe township	robinsville	west windsor
0	1	0	0
1	1	0	0
2	1	0	0
3	1	0	0
4	1	0	0
5	0	0	1
6	0	0	1
7	0	0	1
8	0	0	1
9	0	1	0
10	0	1	0
11	0	1	0
12	0	1	0

In [4]:
```
# concatenate dummy variables with my original dataframes
merged = pd.concat([df,dummies],axis = 'columns')
merged
```

Out[4]:

	town	area	price	monroe township	robinsville	west windsor
0	monroe township	2600	550000	1	0	0
1	monroe township	3000	565000	1	0	0
2	monroe township	3200	610000	1	0	0
3	monroe township	3600	680000	1	0	0
4	monroe township	4000	725000	1	0	0
5	west windsor	2600	585000	0	0	1
6	west windsor	2800	615000	0	0	1
7	west windsor	3300	650000	0	0	1
8	west windsor	3600	710000	0	0	1
9	robinsville	2600	575000	0	1	0
10	robinsville	2900	600000	0	1	0
11	robinsville	3100	620000	0	1	0
12	robinsville	3600	695000	0	1	0

In [5]:
```
# drop town column because you already have this information and it is not work or
final = merged.drop('town',axis='columns')
final
```

Out[5]:

	area	price	monroe township	robinsville	west windsor
0	2600	550000	1	0	0
1	3000	565000	1	0	0
2	3200	610000	1	0	0
3	3600	680000	1	0	0
4	4000	725000	1	0	0
5	2600	585000	0	0	1
6	2800	615000	0	0	1
7	3300	650000	0	0	1
8	3600	710000	0	0	1
9	2600	575000	0	1	0
10	2900	600000	0	1	0
11	3100	620000	0	1	0
12	3600	695000	0	1	0

In [6]:
```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
```

In [7]:
```
# x variable is all of columns except price
x = final.drop('price',axis='columns')
x
```

Out[7]:

	area	monroe township	robinsville	west windsor
0	2600	1	0	0
1	3000	1	0	0
2	3200	1	0	0
3	3600	1	0	0
4	4000	1	0	0
5	2600	0	0	1
6	2800	0	0	1
7	3300	0	0	1
8	3600	0	0	1
9	2600	0	1	0
10	2900	0	1	0
11	3100	0	1	0
12	3600	0	1	0

In [8]:
```
# y is price
y = final.price
y
```

Out[8]:
```
0     550000
1     565000
2     610000
3     680000
4     725000
5     585000
6     615000
7     650000
8     710000
9     575000
10    600000
11    620000
12    695000
Name: price, dtype: int64
```

In [9]:
```
# fitting x & y to Linear Regression Model
model.fit(x,y)
```

Out[9]:
```
LinearRegression()
```

Problem

Bhild a predictor function to predict price of a home,
1. With 3400 sqr ft area in west windsor
2. 2800 sqr ft home in robbinsville

Prediction

1. With 3400 sqr ft area in west windsor

In [10]:
```
model.predict([[3400,0,0,1]])
```

Out[10]:
```
array([681241.66845839])
```

2. 2800 sqr ft area home in robbinsville

In [11]:
```
model.predict([[2800,0,1,0]])
```

Out[11]:
```
array([590775.6396474])
```

Measure the accuracy of your model

In [12]:
```
model.score(x,y)
```

Out[12]:
```
0.9573929037221875
```

Use sklearn OneHotEncoder

In [13]:
```
df
```

Out[13]:

	town	area	price
0	monroe township	2600	550000
1	monroe township	3000	565000
2	monroe township	3200	610000
3	monroe township	3600	680000
4	monroe township	4000	725000
5	west windsor	2600	585000
6	west windsor	2800	615000
7	west windsor	3300	650000
8	west windsor	3600	710000
9	robinsville	2600	575000
10	robinsville	2900	600000
11	robinsville	3100	620000
12	robinsville	3600	695000

In order to use OneHotEncoder first you need to label encoding into town column

In [32]:
```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
```

In [33]:
```
dfle=df
le.fit_transform(dfle.town)
```

Out[33]:
```
array([0, 0, 0, 0, 0, 2, 2, 2, 2, 1, 1, 1, 1], dtype=int64)
```

fit_transform takes the town column and it will return the labels.

In [34]:
```
dfle.town = le.fit_transform(dfle.town)
dfle
```

Out[34]:

	town	area	price
0	0	2600	550000
1	0	3000	565000
2	0	3200	610000
3	0	3600	680000
4	0	4000	725000
5	2	2600	585000
6	2	2800	615000
7	2	3300	650000
8	2	3600	710000
9	1	2600	575000
10	1	2900	600000
11	1	3100	620000
12	1	3600	695000

In [35]:
```
x = dfle[['town','area']].values
x
```

Out[35]:
```
array([[   0, 2600],
       [   0, 3000],
       [   0, 3200],
       [   0, 3600],
       [   0, 4000],
       [   2, 2600],
       [   2, 2800],
       [   2, 3300],
       [   2, 3600],
       [   1, 2600],
       [   1, 2900],
       [   1, 3100],
       [   1, 3600]], dtype=int64)
```

In [36]:
```
y=dfle.price
y
```

Out[36]:
```
0     550000
1     565000
2     610000
3     680000
4     725000
5     585000
6     615000
7     650000
8     710000
9     575000
10    600000
11    620000
12    695000
Name: price, dtype: int64
```

Now we need to create dummy variable encoder

In [37]:
```
from sklearn.preprocessing import LabelEncoder,OneHotEncoder
from sklearn.compose import ColumnTransformer
ct = ColumnTransformer([('town',OneHotEncoder(),[0])],remainder='passthrough')
# you need to specify the column you want to convert to OneHotEncoder
```

In [41]:
```
X = ct.fit_transform(x)
X
```

Out[41]:
```
array([[1.0e+00, 0.0e+00, 0.0e+00, 2.6e+03],
       [1.0e+00, 0.0e+00, 0.0e+00, 3.0e+03],
       [1.0e+00, 0.0e+00, 0.0e+00, 3.2e+03],
       [1.0e+00, 0.0e+00, 0.0e+00, 3.6e+03],
       [1.0e+00, 0.0e+00, 0.0e+00, 4.0e+03],
       [0.0e+00, 0.0e+00, 1.0e+00, 2.6e+03],
       [0.0e+00, 0.0e+00, 1.0e+00, 2.8e+03],
       [0.0e+00, 0.0e+00, 1.0e+00, 3.3e+03],
       [0.0e+00, 0.0e+00, 1.0e+00, 3.6e+03],
       [0.0e+00, 1.0e+00, 0.0e+00, 2.6e+03],
       [0.0e+00, 1.0e+00, 0.0e+00, 2.9e+03],
       [0.0e+00, 1.0e+00, 0.0e+00, 3.1e+03],
       [0.0e+00, 1.0e+00, 0.0e+00, 3.6e+03]])
```

In [43]:
```
# drop the first column
# take all the rows but for colums start from 1 not 0
X = X[:,1:]
X
```

Out[43]:
```
array([[0.0e+00, 0.0e+00, 2.6e+03],
       [0.0e+00, 0.0e+00, 3.0e+03],
       [0.0e+00, 0.0e+00, 3.2e+03],
       [0.0e+00, 0.0e+00, 3.6e+03],
       [0.0e+00, 0.0e+00, 4.0e+03],
       [0.0e+00, 1.0e+00, 2.6e+03],
       [0.0e+00, 1.0e+00, 2.8e+03],
       [0.0e+00, 1.0e+00, 3.3e+03],
       [0.0e+00, 1.0e+00, 3.6e+03],
       [1.0e+00, 0.0e+00, 2.6e+03],
       [1.0e+00, 0.0e+00, 2.9e+03],
       [1.0e+00, 0.0e+00, 3.1e+03],
       [1.0e+00, 0.0e+00, 3.6e+03]])
```

In [44]:
```
model.fit(X,y)
```

Out[44]:
```
LinearRegression()
```

Prediction

With 3400 sqr ft area in west windsor

In [47]:
```
model.predict([[0,1,3400]])
```

Out[47]:
```
array([681241.6684584])
```

2800 sqr ft area home in robbinsville

In [46]:
```
model.predict([[1,0,2800]])
```

Out[46]:
```
array([590775.63964739])
```

Excercise

At the same level as this notebook on github, there is an Exercise folder that contains carprices.csv. This file has car sell prices for 3 different models. First plot data points on a scatter plot chart to see if linear regression model can be applied. If yes, then build a model that can answer following questions,

1) Predict price of a mercedez benz that is 4 yr old with mileage 45000

2) Predict price of a BMW X5 that is 7 yr old with mileage 86000

3) Tell me the score (accuracy) of your model. (Hint: use LinearRegression().score())

Solution

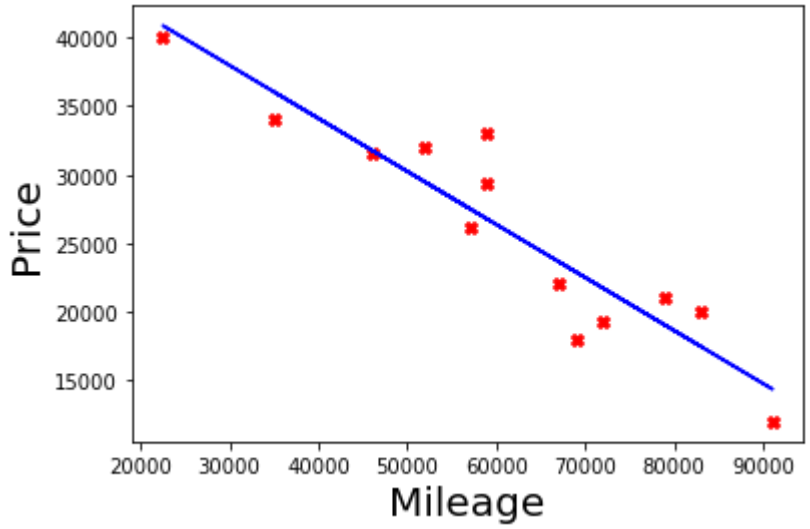
In [48]:
```
import pandas as pd
df = pd.read_csv("D:/Data_Science/My Github/Machine-Learning-with-Python/5. One Ho
df
```

Out[48]:

	car	mileage	price	age
0	BMW X5	69000	18000	6
1	BMW X5	35000	34000	3
2	BMW X5	57000	26100	5
3	BMW X5	22500	40000	2
4	BMW X5	46000	31500	4
5	Audi A5	59000	29400	5
6	Audi A5	52000	32000	5
7	Audi A5	72000	19300	6
8	Audi A5	91000	12000	8
9	Mercedez Benz C class	67000	22000	6
10	Mercedez Benz C class	83000	20000	7
11	Mercedez Benz C class	79000	21000	7
12	Mercedez Benz C class	59000	33000	5

In [50]:
```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
model = LinearRegression()
```

In [53]:
```
%matplotlib inline
model = model.fit(df[['mileage']],df.price)
fig1 = plt.figure()
plt.xlabel('Mileage',fontsize=20)
plt.ylabel('Price',fontsize=20)
plt.scatter(df.mileage,df.price,color='red',marker='X')
plt.plot(df.mileage,model.predict(df[['mileage']]),color='blue')
plt.show()
```



OneHotEncoder

In [54]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
df.car = le.fit_transform(df.car)
df
```

Out[54]:

	car	mileage	price	age
0	1	69000	18000	6
1	1	35000	34000	3
2	1	57000	26100	5
3	1	22500	40000	2
4	1	46000	31500	4
5	0	59000	29400	5
6	0	52000	32000	5
7	0	72000	19300	6
8	0	91000	12000	8
9	2	67000	22000	6
10	2	83000	20000	7
11	2	79000	21000	7
12	2	59000	33000	5

In [55]:
```
X = df[['car','mileage','age']].values
X
```

Out[55]:
```
array([[    1, 69000,     6],
       [    1, 35000,     3],
       [    1, 57000,     5],
       [    1, 22500,     2],
       [    1, 46000,     4],
       [    0, 59000,     5],
       [    0, 52000,     5],
       [    0, 72000,     6],
       [    0, 91000,     8],
       [    2, 67000,     6],
       [    2, 83000,     7],
       [    2, 79000,     7],
       [    2, 59000,     5]], dtype=int64)
```

In [56]:
```
Y = df.price
Y
```

Out[56]:
```
0     18000
1     34000
2     26100
3     40000
4     31500
5     29400
6     32000
7     19300
8     12000
9     22000
10    20000
11    21000
12    33000
Name: price, dtype: int64
```

In [57]:
```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
from sklearn.compose import ColumnTransformer
ct = ColumnTransformer([('car',OneHotEncoder(),[0])],remainder='passthrough')
```

In [58]:
```
ct = ct.fit_transform(X)
ct
```

Out[58]:
```
array([[0.00e+00, 1.00e+00, 0.00e+00, 6.90e+04, 6.00e+00],
       [0.00e+00, 1.00e+00, 0.00e+00, 3.50e+04, 3.00e+00],
       [0.00e+00, 1.00e+00, 0.00e+00, 5.70e+04, 5.00e+00],
       [0.00e+00, 1.00e+00, 0.00e+00, 2.25e+04, 2.00e+00],
       [0.00e+00, 1.00e+00, 0.00e+00, 4.60e+04, 4.00e+00],
       [1.00e+00, 0.00e+00, 0.00e+00, 5.90e+04, 5.00e+00],
       [1.00e+00, 0.00e+00, 0.00e+00, 5.20e+04, 5.00e+00],
       [1.00e+00, 0.00e+00, 0.00e+00, 7.20e+04, 6.00e+00],
       [1.00e+00, 0.00e+00, 0.00e+00, 9.10e+04, 8.00e+00],
       [0.00e+00, 0.00e+00, 1.00e+00, 6.70e+04, 6.00e+00],
       [0.00e+00, 0.00e+00, 1.00e+00, 8.30e+04, 7.00e+00],
       [0.00e+00, 0.00e+00, 1.00e+00, 7.90e+04, 7.00e+00],
       [0.00e+00, 0.00e+00, 1.00e+00, 5.90e+04, 5.00e+00]])
```

In [59]:
```
ct = ct[:,1:]
ct
```

Out[59]:
```
array([[1.00e+00, 0.00e+00, 6.90e+04, 6.00e+00],
       [1.00e+00, 0.00e+00, 3.50e+04, 3.00e+00],
       [1.00e+00, 0.00e+00, 5.70e+04, 5.00e+00],
       [1.00e+00, 0.00e+00, 2.25e+04, 2.00e+00],
       [1.00e+00, 0.00e+00, 4.60e+04, 4.00e+00],
       [0.00e+00, 0.00e+00, 5.90e+04, 5.00e+00],
       [0.00e+00, 0.00e+00, 5.20e+04, 5.00e+00],
       [0.00e+00, 0.00e+00, 7.20e+04, 6.00e+00],
       [0.00e+00, 0.00e+00, 9.10e+04, 8.00e+00],
       [0.00e+00, 1.00e+00, 6.70e+04, 6.00e+00],
       [0.00e+00, 1.00e+00, 8.30e+04, 7.00e+00],
       [0.00e+00, 1.00e+00, 7.90e+04, 7.00e+00],
       [0.00e+00, 1.00e+00, 5.90e+04, 5.00e+00]])
```

In [60]:
```
model.fit(ct,Y)
```

Out[60]:
```
LinearRegression()
```

Price of mercedez benz that is 4 yr old with mileage 45000

In [61]:
```
model.predict([[0,1,45000,4]])
```

Out[61]:
```
array([36991.31721062])
```

Price of BMW X5 that is 7 yr old with mileage 86000

In [62]:
```
model.predict([[1,0,86000,7]])
```

Out[62]:
```
array([11080.74313219])
```

model accuracy

In [63]:
```
model.score(ct,Y)
```

Out[63]:
```
0.9417050937281083
```

Date	Author
2021-08-25	Ehsan Zia