importing required files

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import os
import warnings
warnings.filterwarnings('ignore')
```

In [2]:
```
print (os.getcwd())
```

```
C:\Users\Dell
```

In [3]:
```
os.chdir ('C:\\Users\\Dell\\OneDrive\\Desktop\\CAR Price Prediction')
```

In [4]:
```
print (os.getcwd())
```

```
C:\Users\Dell\OneDrive\Desktop\CAR Price Prediction
```

reading data

In [5]:
```
data=pd.read_csv("C:\\Users\\Dell\\OneDrive\\Desktop\\excel books\\audi.csv")
display(data)
```

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize
0	A1	2017	12500	Manual	15735	Petrol	150	55.4	1.4
1	A6	2016	16500	Automatic	36203	Diesel	20	64.2	2.0
2	A1	2016	11000	Manual	29946	Petrol	30	55.4	1.4
3	A4	2017	16800	Automatic	25952	Diesel	145	67.3	2.0
4	A3	2019	17300	Manual	1998	Petrol	145	49.6	1.0
...	...	...	...	...	...	...	...	...	...
10663	A3	2020	16999	Manual	4018	Petrol	145	49.6	1.0
10664	A3	2020	16999	Manual	1978	Petrol	150	49.6	1.0
10665	A3	2020	17199	Manual	609	Petrol	150	49.6	1.0
10666	Q3	2017	19499	Automatic	8646	Petrol	150	47.9	1.4
10667	Q3	2016	15999	Manual	11855	Petrol	150	47.9	1.4

10668 rows × 9 columns

In [6]:
```
import pandas_profiling as pp
```

In [7]:
```
display(pp.ProfileReport(data))
```

```
Summarize dataset:   0%|          | 0/5 [00:00<?, ?it/s]
Generate report structure:   0%|          | 0/1 [00:00<?, ?it/s]
Render HTML:   0%|          | 0/1 [00:00<?, ?it/s]
```

Overview

Dataset statistics

Number of variables	9
Number of observations	10668
Missing cells	0
Missing cells (%)	0.0%
Duplicate rows	82
Duplicate rows (%)	0.8%
Total size in memory	750.2 KiB
Average record size in memory	72.0 B

Variable types

Categorical	3
Numeric	6

Alerts

Dataset has 82 (0.8%) duplicate rows	**Duplicates**
`year` is highly overall correlated with `price` and 2 other fields (price, dist_travelled, mpg)	**High correlation**
`price` is highly overall correlated with `year` and 2 other	**High correlation**

manual data Exploration

In [8]:
```
print(len(data))
```

```
10668
```

In [9]:
```
print(data.shape)
```

```
(10668, 9)
```

In [10]:
```
display (data.dtypes )
```

```
model              object
year                int64
price               int64
transmission       object
dist_travelled      int64
fuelType           object
tax                 int64
mpg               float64
engineSize        float64
dtype: object
```

In [11]:
```
display (data.isna().sum() )
```

```
model             0
year              0
price             0
transmission      0
dist_travelled    0
fuelType          0
tax               0
mpg               0
engineSize        0
dtype: int64
```

In [12]:
```
print (data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10668 entries, 0 to 10667
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   model           10668 non-null  object 
 1   year            10668 non-null  int64  
 2   price           10668 non-null  int64  
 3   transmission    10668 non-null  object 
 4   dist_travelled  10668 non-null  int64  
 5   fuelType        10668 non-null  object 
 6   tax             10668 non-null  int64  
 7   mpg             10668 non-null  float64
 8   engineSize      10668 non-null  float64
dtypes: float64(2), int64(4), object(3)
memory usage: 750.2+ KB
None
```

In [13]:
```
display (data.describe ())
```

	year	price	dist_travelled	tax	mpg	engineSize
count	10668.000000	10668.000000	10668.000000	10668.000000	10668.000000	10668.000000
mean	2017.100675	22896.685039	24827.244001	126.011436	50.770022	1.930709
std	2.167494	11714.841888	23505.257205	67.170294	12.949782	0.602957
min	1997.000000	1490.000000	1.000000	0.000000	18.900000	0.000000
25%	2016.000000	15130.750000	5968.750000	125.000000	40.900000	1.500000
50%	2017.000000	20200.000000	19000.000000	145.000000	49.600000	2.000000
75%	2019.000000	27990.000000	36464.500000	145.000000	58.900000	2.000000
max	2020.000000	145000.000000	323000.000000	580.000000	188.300000	6.300000

In [14]:
```
data
```

Out[14]:

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize
0	A1	2017	12500	Manual	15735	Petrol	150	55.4	1.4
1	A6	2016	16500	Automatic	36203	Diesel	20	64.2	2.0
2	A1	2016	11000	Manual	29946	Petrol	30	55.4	1.4
3	A4	2017	16800	Automatic	25952	Diesel	145	67.3	2.0
4	A3	2019	17300	Manual	1998	Petrol	145	49.6	1.0
...	...	...	...	...	...	...	...	...	...
10663	A3	2020	16999	Manual	4018	Petrol	145	49.6	1.0
10664	A3	2020	16999	Manual	1978	Petrol	150	49.6	1.0
10665	A3	2020	17199	Manual	609	Petrol	150	49.6	1.0
10666	Q3	2017	19499	Automatic	8646	Petrol	150	47.9	1.4
10667	Q3	2016	15999	Manual	11855	Petrol	150	47.9	1.4

10668 rows × 9 columns

In [15]:
```
data.drop_duplicates(subset=['model','year','price','transmission','dist_travelled'
```

In [16]:
```
data.shape
```

Out[16]:
```
(10565, 9)
```

In [17]:
```
X = data.iloc[:,[0,1,3,4,5,6,7,8]].values
display (X.shape)
display (X)
```

```
(10565, 8)
array([[' A1', 2017, 'Manual', ..., 150, 55.4, 1.4],
       [' A6', 2016, 'Automatic', ..., 20, 64.2, 2.0],
       [' A1', 2016, 'Manual', ..., 30, 55.4, 1.4],
       ...,
       [' A3', 2020, 'Manual', ..., 150, 49.6, 1.0],
       [' Q3', 2017, 'Automatic', ..., 150, 47.9, 1.4],
       [' Q3', 2016, 'Manual', ..., 150, 47.9, 1.4]], dtype=object)
```

In [18]:
```
data.head()
```

Out[18]:

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize
0	A1	2017	12500	Manual	15735	Petrol	150	55.4	1.4
1	A6	2016	16500	Automatic	36203	Diesel	20	64.2	2.0
2	A1	2016	11000	Manual	29946	Petrol	30	55.4	1.4
3	A4	2017	16800	Automatic	25952	Diesel	145	67.3	2.0
4	A3	2019	17300	Manual	1998	Petrol	145	49.6	1.0

In [19]:
```
Y = data.iloc[:,[2]].values
display (Y.shape)
display (Y)
```

```
(10565, 1)
```

```
array([[12500],
       [16500],
       [11000],
       ...,
       [17199],
       [19499],
       [15999]], dtype=int64)
```

In [20]:
```
display(pd.DataFrame(X).head(5))
```

	0	1	2	3	4	5	6	7
0	A1	2017	Manual	15735	Petrol	150	55.4	1.4
1	A6	2016	Automatic	36203	Diesel	20	64.2	2.0
2	A1	2016	Manual	29946	Petrol	30	55.4	1.4
3	A4	2017	Automatic	25952	Diesel	145	67.3	2.0
4	A3	2019	Manual	1998	Petrol	145	49.6	1.0

Label Encoding

In [21]:
```
from sklearn.preprocessing import LabelEncoder
```

In [22]:
```
le1 = LabelEncoder()
X[:,0] = le1.fit_transform(X[:,0])
le2 = LabelEncoder()
X[:,-4] = le2.fit_transform(X[:,-4])
display (X)
```

```
array([[0, 2017, 'Manual', ..., 150, 55.4, 1.4],
       [5, 2016, 'Automatic', ..., 20, 64.2, 2.0],
       [0, 2016, 'Manual', ..., 30, 55.4, 1.4],
       ...,
       [2, 2020, 'Manual', ..., 150, 49.6, 1.0],
       [9, 2017, 'Automatic', ..., 150, 47.9, 1.4],
       [9, 2016, 'Manual', ..., 150, 47.9, 1.4]], dtype=object)
```

one hot encoding

In [23]:
```
from sklearn.preprocessing import OneHotEncoder
from sklearn.compose import ColumnTransformer
ct = ColumnTransformer(transformers = [('encoder',OneHotEncoder(),[2])],remainder='
X = ct.fit_transform(X)
display (X.shape)
display (pd.DataFrame(X))
```

```
(10565, 10)
```

	0	1	2	3	4	5	6	7	8	9
0	0.0	1.0	0.0	0	2017	15735	2	150	55.4	1.4
1	1.0	0.0	0.0	5	2016	36203	0	20	64.2	2.0
2	0.0	1.0	0.0	0	2016	29946	2	30	55.4	1.4
3	1.0	0.0	0.0	3	2017	25952	0	145	67.3	2.0
4	0.0	1.0	0.0	2	2019	1998	2	145	49.6	1.0
...	...	...	...	...	...	...	...	...	...	...
10560	0.0	1.0	0.0	2	2020	4018	2	145	49.6	1.0
10561	0.0	1.0	0.0	2	2020	1978	2	150	49.6	1.0
10562	0.0	1.0	0.0	2	2020	609	2	150	49.6	1.0
10563	1.0	0.0	0.0	9	2017	8646	2	150	47.9	1.4
10564	0.0	1.0	0.0	9	2016	11855	2	150	47.9	1.4

10565 rows × 10 columns

Standardizing the data

In [24]:
```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X = sc.fit_transform(X)
display (pd.DataFrame(X))
```

	0	1	2	3	4	5	6	7	
0	-0.582997	1.203038	-0.714096	-1.119276	-0.039002	-0.393254	1.053589	0.357402	0.35
1	1.715274	-0.831229	-0.714096	-0.158819	-0.500425	0.479662	-0.951665	-1.571222	1.03
2	-0.582997	1.203038	-0.714096	-1.119276	-0.500425	0.212815	1.053589	-1.422867	0.35
3	1.715274	-0.831229	-0.714096	-0.543002	-0.039002	0.042479	-0.951665	0.283224	1.26
4	-0.582997	1.203038	-0.714096	-0.735093	0.883845	-0.979108	1.053589	0.283224	-0.09
...	...	...	...	...	...	...	...	...	
10560	-0.582997	1.203038	-0.714096	-0.735093	1.345269	-0.892959	1.053589	0.283224	-0.09
10561	-0.582997	1.203038	-0.714096	-0.735093	1.345269	-0.979961	1.053589	0.357402	-0.09
10562	-0.582997	1.203038	-0.714096	-0.735093	1.345269	-1.038346	1.053589	0.357402	-0.09
10563	1.715274	-0.831229	-0.714096	0.609547	-0.039002	-0.695585	1.053589	0.357402	-0.22
10564	-0.582997	1.203038	-0.714096	0.609547	-0.500425	-0.558728	1.053589	0.357402	-0.22

10565 rows × 10 columns

spliting data to train and test the model

In [25]:
```
from sklearn.model_selection import train_test_split
```

```
(X_train,X_test,Y_train,Y_test) = train_test_split(X,Y,test_size=0.2,random_state=0


print (X_train.shape, Y_train.shape)
print(Y_test.shape)
```

```
(8452, 10) (8452, 1)
(2113, 1)
```

In [ ]:

using regression

In [26]:
```
from sklearn.linear_model import LinearRegression
reg = LinearRegression()
reg.fit(X_train,Y_train)
```

Out[26]:
```
LinearRegression()
```

In [ ]:

In [27]:
```
y_pred = reg.predict(X_test)
display (y_pred.shape)
```

```
(2113, 1)
```

In [ ]:

In [28]:
```
print(np.concatenate((y_pred.reshape(len(y_pred),1),Y_test.reshape(len(Y_test),1)),
```

```
[[31863.18288911 34991.        ]
 [19374.13511826 17299.        ]
 [13295.65796165 11444.        ]
 ...
 [18373.48622929 17670.        ]
 [20230.20801119 14290.        ]
 [17652.48622929 18990.        ]]
```

In [ ]:

checking for accuracy

In [29]:
```
from sklearn.metrics import r2_score,mean_absolute_error
print('R2 Score ', r2_score(Y_test, y_pred))
print('Mean Absolute Error', mean_absolute_error(Y_test,y_pred))
```

```
R2 Score  0.7941818440937328
Mean Absolute Error 3244.810815892843
```

In [30]:
```
y_pred = reg.predict(X)
display (y_pred)
y_pred=y_pred[:2113,0]
```

```
array([[14861.39031251],
       [20407.69760853],
       [13617.39031251],
       ...,
       [19728.17779394],
       [21238.75145114],
       [16811.25145114]])
```

In [31]:
```
result = pd.concat([data,pd.DataFrame(y_pred)],axis=1)
display( result.head())
result.rename(columns={0: 'pred_price'}, inplace=True)
display( result)
```

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize	
0	A1	2017.0	12500.0	Manual	15735.0	Petrol	150.0	55.4	1.4	14861.3
1	A6	2016.0	16500.0	Automatic	36203.0	Diesel	20.0	64.2	2.0	20407.6
2	A1	2016.0	11000.0	Manual	29946.0	Petrol	30.0	55.4	1.4	13617.3
3	A4	2017.0	16800.0	Automatic	25952.0	Diesel	145.0	67.3	2.0	20163.3
4	A3	2019.0	17300.0	Manual	1998.0	Petrol	145.0	49.6	1.0	17648.1

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize	p
0	A1	2017.0	12500.0	Manual	15735.0	Petrol	150.0	55.4	1.4	148
1	A6	2016.0	16500.0	Automatic	36203.0	Diesel	20.0	64.2	2.0	204
2	A1	2016.0	11000.0	Manual	29946.0	Petrol	30.0	55.4	1.4	136
3	A4	2017.0	16800.0	Automatic	25952.0	Diesel	145.0	67.3	2.0	201
4	A3	2019.0	17300.0	Manual	1998.0	Petrol	145.0	49.6	1.0	176
...	...	...	...	...	...	...	...	...	...	
1162	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	200
1563	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	76
1564	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	220
1874	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	211
1875	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	137

10578 rows × 10 columns

In [32]:
```
data
```

Out[32]:

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize
0	A1	2017	12500	Manual	15735	Petrol	150	55.4	1.4
1	A6	2016	16500	Automatic	36203	Diesel	20	64.2	2.0
2	A1	2016	11000	Manual	29946	Petrol	30	55.4	1.4
3	A4	2017	16800	Automatic	25952	Diesel	145	67.3	2.0
4	A3	2019	17300	Manual	1998	Petrol	145	49.6	1.0
...	...	...	...	...	...	...	...	...	...
10663	A3	2020	16999	Manual	4018	Petrol	145	49.6	1.0
10664	A3	2020	16999	Manual	1978	Petrol	150	49.6	1.0
10665	A3	2020	17199	Manual	609	Petrol	150	49.6	1.0
10666	Q3	2017	19499	Automatic	8646	Petrol	150	47.9	1.4
10667	Q3	2016	15999	Manual	11855	Petrol	150	47.9	1.4

10565 rows × 9 columns

In [33]:
```
actual=data.iloc[:2113,2]
actual
distance=data.iloc[:2113,4]
print(distance)
```

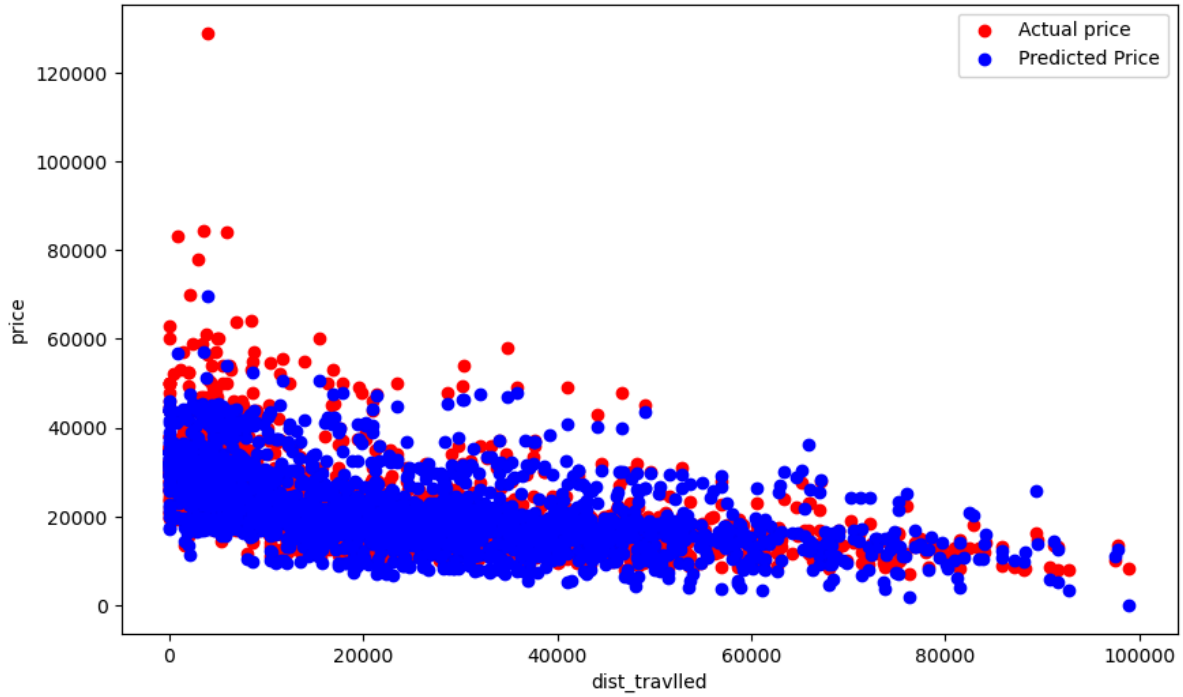
```
0       15735
1       36203
2       29946
3       25952
4        1998
        ...
2121    52595
2122    25000
2123    31292
2124    49652
2125    15016
Name: dist_travelled, Length: 2113, dtype: int64
```

In [34]:
```
print(distance.shape)
print(y_pred.shape)
```

```
(2113,)
(2113,)
```

In [35]:
```
%matplotlib inline
plt.figure(figsize=(10, 6))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,actual,color='red')
plt.scatter(distance,y_pred,color='blue')

plt.legend(['Actual price ','Predicted Price'])
plt.show()
```



In [ ]:

using random forest regressor

In [ ]:

In [ ]:

In [36]:
```
from sklearn.ensemble import RandomForestRegressor
regression = RandomForestRegressor(random_state=0)
regression.fit(X_train,Y_train)
display (regression)
```

```
RandomForestRegressor(random_state=0)
```

In [37]:
```
from sklearn.model_selection import train_test_split

(X_train,X_test,Y_train,Y_test) = train_test_split(X,Y,test_size=0.2,random_state=0


print (X_train.shape, Y_train.shape)
print (X_test.shape, Y_test.shape)
```

```
(8452, 10) (8452, 1)
(2113, 10) (2113, 1)
```

In [38]:
```
y_pred = regression.predict(X_test)
display (y_pred)
```

```
array([34565.81, 16820.73, 11530.84, ..., 18497.45, 17153.97, 18620.66])
```

In [39]:
```
result = pd.concat([data,pd.DataFrame(y_pred)],axis=1)
display( result.tail(50))
result.rename(columns={0: 'pred_price'}, inplace=True)
display( result)
```

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize
10631	TT	2012.0	10490.0	Manual	24693.0	Diesel	165.0	51.4	2.0
10632	A1	2010.0	9990.0	Automatic	38000.0	Petrol	125.0	53.3	1.4
10633	A4	2018.0	26891.0	Automatic	22414.0	Petrol	145.0	36.7	3.0
10634	Q7	2017.0	45595.0	Automatic	28949.0	Diesel	145.0	39.2	4.0
10635	A3	2016.0	18000.0	Automatic	29494.0	Petrol	125.0	49.6	2.0
10636	A1	2013.0	9291.0	Manual	29382.0	Petrol	125.0	53.3	1.4
10637	A5	2017.0	21291.0	Automatic	29666.0	Diesel	30.0	65.7	2.0
10638	A4	2017.0	18491.0	Automatic	17900.0	Petrol	145.0	50.4	1.4
10639	A6	2020.0	28000.0	Automatic	2511.0	Diesel	145.0	47.9	2.0
10640	Q5	2020.0	37000.0	Automatic	1436.0	Petrol	145.0	32.1	2.0
10641	A5	2020.0	25000.0	Automatic	751.0	Petrol	145.0	40.4	2.0
10642	Q5	2019.0	33000.0	Automatic	5207.0	Diesel	145.0	38.2	2.0
10643	A4	2019.0	30000.0	Automatic	9900.0	Diesel	145.0	49.6	2.0
10644	A5	2019.0	25000.0	Automatic	8571.0	Diesel	145.0	46.3	2.0
10645	A1	2016.0	10999.0	Manual	22150.0	Diesel	0.0	76.3	1.6
10646	A1	2016.0	12380.0	Manual	40119.0	Petrol	30.0	55.4	1.4
10647	A3	2015.0	21000.0	Automatic	12084.0	Petrol	205.0	39.8	2.0
10648	RS6	2016.0	49990.0	Automatic	24000.0	Petrol	325.0	29.4	4.0
10649	A3	2009.0	3750.0	Manual	120000.0	Diesel	145.0	53.3	2.0
10650	A4	2011.0	6995.0	Manual	88000.0	Diesel	30.0	61.4	2.0
10651	A3	2011.0	9695.0	Manual	32300.0	Petrol	235.0	39.2	2.0
10652	A1	2014.0	9995.0	Manual	54000.0	Petrol	30.0	55.4	1.2
10653	A3	2017.0	12995.0	Manual	23820.0	Petrol	145.0	60.1	1.0
10654	A3	2016.0	16495.0	Semi-Auto	46600.0	Diesel	125.0	57.6	2.0
10655	S4	2018.0	29995.0	Automatic	29000.0	Petrol	150.0	35.8	3.0
10656	A3	2016.0	15495.0	Semi-Auto	52500.0	Hybrid	0.0	176.6	1.4
10657	A4	2016.0	20995.0	Semi-Auto	23700.0	Diesel	30.0	61.4	2.0
10658	A3	2016.0	14995.0	Manual	39750.0	Petrol	30.0	57.6	1.4
10659	A6	2018.0	27995.0	Semi-Auto	27500.0	Petrol	150.0	39.8	2.0
10660	A4	2011.0	9995.0	Automatic	78000.0	Diesel	305.0	39.8	3.0
10661	A4	2011.0	6995.0	Manual	95000.0	Diesel	145.0	53.3	2.0
10662	A3	2013.0	12695.0	Manual	31500.0	Petrol	125.0	53.3	1.4
10663	A3	2020.0	16999.0	Manual	4018.0	Petrol	145.0	49.6	1.0
10664	A3	2020.0	16999.0	Manual	1978.0	Petrol	150.0	49.6	1.0
10665	A3	2020.0	17199.0	Manual	609.0	Petrol	150.0	49.6	1.0
10666	Q3	2017.0	19499.0	Automatic	8646.0	Petrol	150.0	47.9	1.4

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize	
10667	Q3	2016.0	15999.0	Manual	11855.0	Petrol	150.0	47.9	1.4	
273	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	2
764	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	2
784	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	3
967	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	11
990	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
1133	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	1
1137	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	1
1146	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	2
1162	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	4
1563	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	3
1564	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	3
1874	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	1
1875	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	2

	model	year	price	transmission	dist_travelled	fuelType	tax	mpg	engineSize	p
0	A1	2017.0	12500.0	Manual	15735.0	Petrol	150.0	55.4	1.4	345
1	A6	2016.0	16500.0	Automatic	36203.0	Diesel	20.0	64.2	2.0	168
2	A1	2016.0	11000.0	Manual	29946.0	Petrol	30.0	55.4	1.4	115
3	A4	2017.0	16800.0	Automatic	25952.0	Diesel	145.0	67.3	2.0	242
4	A3	2019.0	17300.0	Manual	1998.0	Petrol	145.0	49.6	1.0	152
...	...	...	...	...	...	...	...	...	...	
1162	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	442
1563	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	324
1564	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	331
1874	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	121
1875	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	253

10578 rows × 10 columns

checking for accuracy

In [40]:
```
from sklearn.metrics import r2_score,mean_absolute_error
print  ('R2 Score ', r2_score(Y_test, y_pred))
print  ('Mean Absolute Error', mean_absolute_error(Y_test,y_pred))
```

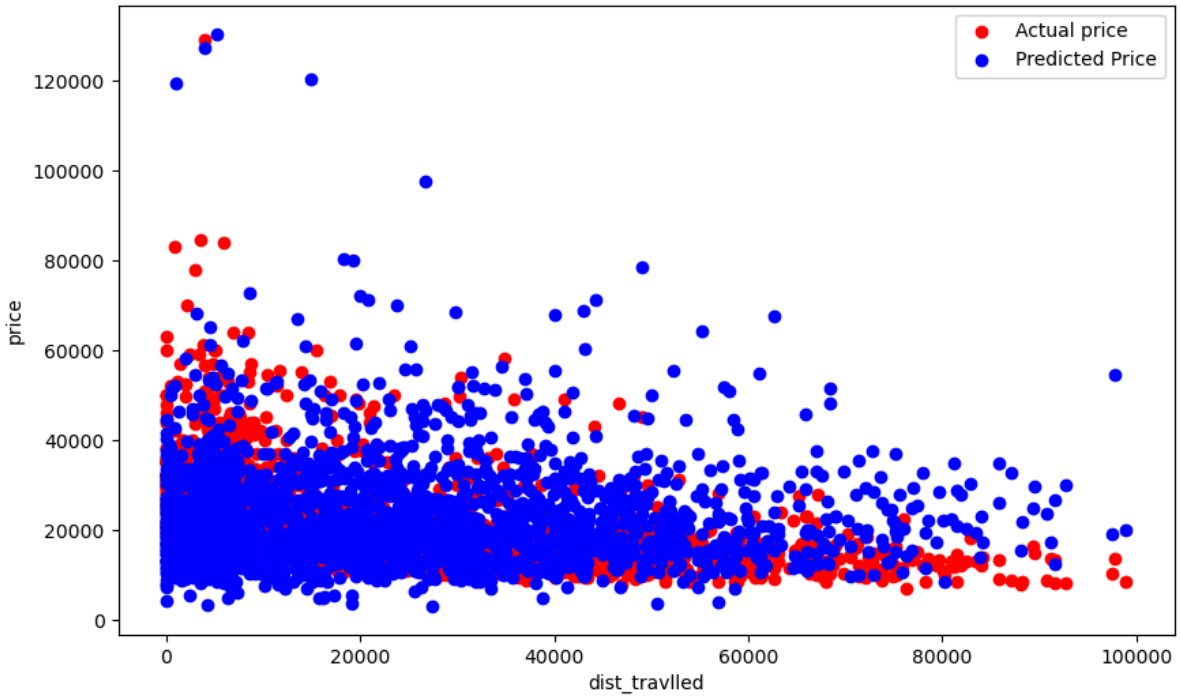
```
R2 Score  0.9587306545197221
Mean Absolute Error 1517.4627789258122
```

In [ ]:
```

```

In [41]:
```
%matplotlib inline
plt.figure(figsize=(10, 6))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,actual,color='red')
plt.scatter(distance,y_pred,color='blue')

plt.legend(['Actual price ','Predicted Price'])
plt.show()
```



In [ ]:
```
```

using extra tree Regressor

In [42]:
```
from sklearn.ensemble import  ExtraTreesRegressor
ET_Model=ExtraTreesRegressor(n_estimators=120)
ET_Model.fit(X_train,Y_train)
y_predict=ET_Model.predict(X_test)
import numpy as np
```

checking for Accuracy

In [43]:
```
from sklearn.metrics import r2_score,mean_absolute_error
print('R2 Score :', r2_score(Y_test, y_predict))
print ('Mean Absolute Error:', mean_absolute_error(Y_test,y_predict))
```

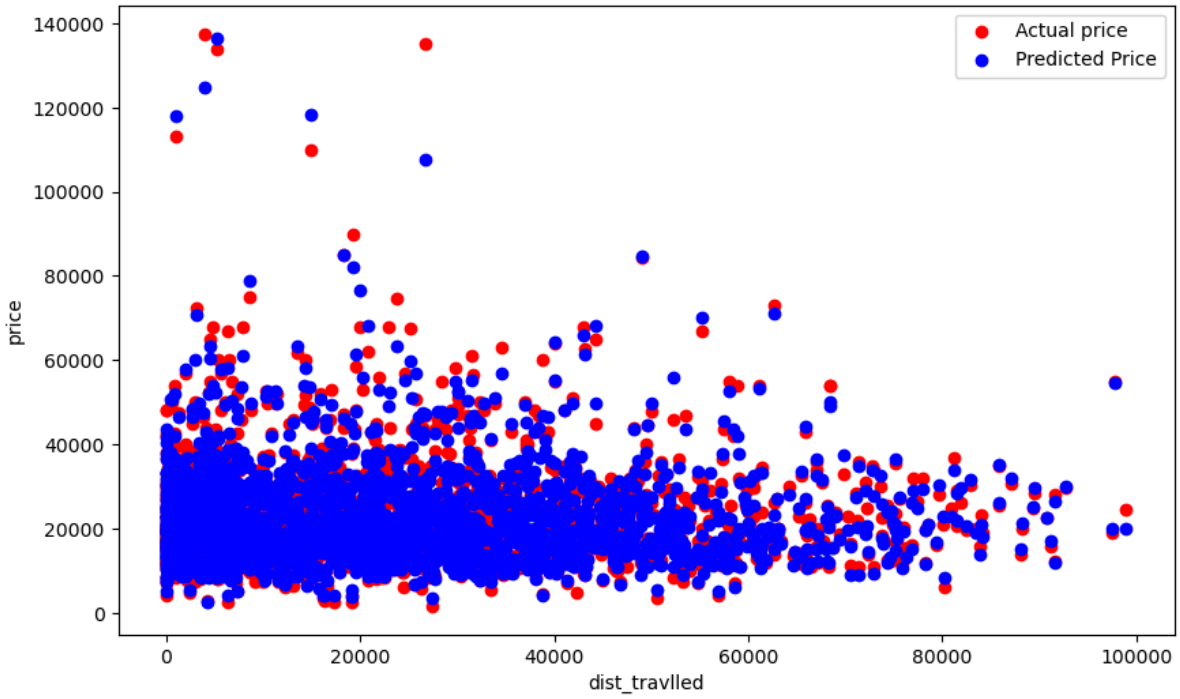
```
R2 Score : 0.9625678491519055
Mean Absolute Error: 1517.800980044171
```

In [44]:
```
'''y_pred = reg.predict(X)
display (y_pred)
result = pd.concat([data,pd.DataFrame(y_pred)],axis=1).head()
display( result)'''
```

Out[44]:
```
'y_pred = reg.predict(X)\ndisplay (y_pred)\nresult = pd.concat([data,pd.DataFrame
(y_pred)],axis=1).head()\ndisplay( result)'
```

In [45]:
```
%matplotlib inline
plt.figure(figsize=(10, 6))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,Y_test,color='red')
plt.scatter(distance,y_predict,color='blue')

plt.legend(['Actual price ','Predicted Price'])
plt.show()
```



In [ ]:

In [ ]:

using randomized search cv on Random forest regressor

In [46]:
```
### Randomized search CV
```

In [47]:
```
from sklearn.model_selection import RandomizedSearchCV
```

In [48]:
```
n_estimators = [int(x) for x in np.linspace(start = 80, stop = 1500, num = 10)]
```

In [49]:
```
max_features = ['auto', 'sqrt']
max_depth = [int(x) for x in np.linspace(6, 45, num = 5)]
min_samples_split = [2, 5, 10, 15, 100]
min_samples_leaf = [1, 2, 5, 10]
```

In [50]:
```
rand_grid={'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf}
```

In [51]:
```
rf=RandomForestRegressor()
```

In [52]:
```
rCV=RandomizedSearchCV(estimator=rf,param_distributions=rand_grid,scoring='neg_mear
```

In [53]:
```
rCV.fit(X_train,Y_train)
```

Out[53]:
```
RandomizedSearchCV(cv=3, estimator=RandomForestRegressor(), n_iter=3, n_jobs=1,
                   param_distributions={'max_depth': [6, 15, 25, 35, 45],
                                        'max_features': ['auto', 'sqrt'],
                                        'min_samples_leaf': [1, 2, 5, 10],
                                        'min_samples_split': [2, 5, 10, 15,
                                                              100],
                                        'n_estimators': [80, 237, 395, 553, 711,
                                                         868, 1026, 1184, 1342,
                                                         1500]},
                   random_state=42, scoring='neg_mean_squared_error')
```

In [54]:
```
rf_pred=rCV.predict(X_test)
display (rf_pred)
```

```
array([34363.68578869, 16651.55211445, 11707.03009425, ...,
       18883.21945933, 16724.75648133, 18457.28272006])
```

In [55]:
```
rf_pred=rCV.predict(X_test)
display (rf_pred)
```

```
array([34363.68578869, 16651.55211445, 11707.03009425, ...,
       18883.21945933, 16724.75648133, 18457.28272006])
```

In [56]:
```
from sklearn.metrics import mean_absolute_error,mean_squared_error
print('MAE',mean_absolute_error(Y_test,rf_pred))
print('MSE',mean_squared_error(Y_test,rf_pred))
```

```
MAE 1505.2773269897075
MSE 6100595.4818421
```

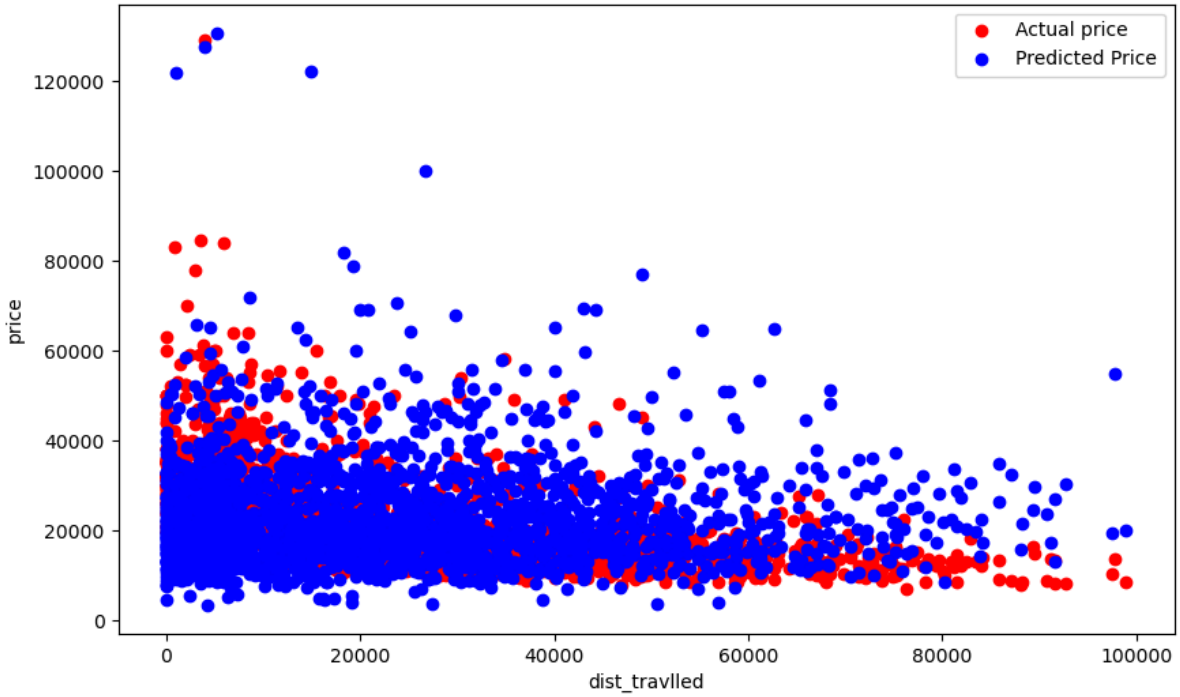
checking for accuracy

In [57]:
```
display (r2_score(Y_test,rf_pred))
```

```
0.9580830027921906
```

In [58]:
```
%matplotlib inline
plt.figure(figsize=(10, 6))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,actual,color='red')
plt.scatter(distance,rf_pred,color='blue')

plt.legend(['Actual price ','Predicted Price'])
plt.show()
```



using Cat boost

In [59]:
```
from catboost import CatBoostRegressor
cat=CatBoostRegressor()
print (cat.fit(X_train,Y_train))
```

```
Learning rate set to 0.057364
0:      learn: 11114.3972284    total: 170ms    remaining: 2m 50s
1:      learn: 10673.2274762    total: 175ms    remaining: 1m 27s
2:      learn: 10206.4353989    total: 177ms    remaining: 58.7s
3:      learn: 9768.7344047     total: 180ms    remaining: 44.7s
4:      learn: 9368.4368856     total: 183ms    remaining: 36.4s
5:      learn: 8968.6665759     total: 186ms    remaining: 30.8s
6:      learn: 8612.6905308     total: 188ms    remaining: 26.7s
7:      learn: 8267.8198589     total: 191ms    remaining: 23.7s
8:      learn: 7937.1451542     total: 193ms    remaining: 21.2s
9:      learn: 7640.8621827     total: 195ms    remaining: 19.3s
10:     learn: 7352.8621338     total: 197ms    remaining: 17.7s
11:     learn: 7082.4483780     total: 199ms    remaining: 16.4s
12:     learn: 6845.5330930     total: 201ms    remaining: 15.2s
13:     learn: 6601.8601574     total: 203ms    remaining: 14.3s
14:     learn: 6377.0053186     total: 206ms    remaining: 13.5s
15:     learn: 6175.5728347     total: 208ms    remaining: 12.8s
16:     learn: 5974.3551277     total: 210ms    remaining: 12.2s
17:     learn: 5783.4229530     total: 212ms    remaining: 11.6s
18:     learn: 5597.5766090     total: 214ms    remaining: 11.1s
19:     learn: 5428.4494209     total: 216ms    remaining: 10.6s
20:     learn: 5279.7470359     total: 219ms    remaining: 10.2s
21:     learn: 5133.9904556     total: 221ms    remaining: 9.81s
22:     learn: 5005.8510902     total: 223ms    remaining: 9.46s
23:     learn: 4866.1184666     total: 225ms    remaining: 9.14s
24:     learn: 4740.9861961     total: 227ms    remaining: 8.85s
25:     learn: 4616.7778128     total: 229ms    remaining: 8.58s
26:     learn: 4504.7863353     total: 231ms    remaining: 8.33s
27:     learn: 4407.6834261     total: 233ms    remaining: 8.1s
28:     learn: 4316.4384917     total: 235ms    remaining: 7.88s
29:     learn: 4221.9001013     total: 237ms    remaining: 7.67s
30:     learn: 4136.2494014     total: 240ms    remaining: 7.49s
31:     learn: 4058.2955743     total: 242ms    remaining: 7.32s
32:     learn: 3979.8338444     total: 245ms    remaining: 7.17s
33:     learn: 3916.0906474     total: 247ms    remaining: 7.03s
34:     learn: 3846.4726044     total: 251ms    remaining: 6.93s
35:     learn: 3775.6208908     total: 256ms    remaining: 6.84s
36:     learn: 3714.6420809     total: 258ms    remaining: 6.72s
37:     learn: 3657.3138342     total: 260ms    remaining: 6.59s
38:     learn: 3603.9100156     total: 263ms    remaining: 6.49s
39:     learn: 3552.6465072     total: 266ms    remaining: 6.38s
40:     learn: 3508.4274547     total: 270ms    remaining: 6.32s
41:     learn: 3464.8838261     total: 274ms    remaining: 6.24s
42:     learn: 3421.2036066     total: 277ms    remaining: 6.16s
43:     learn: 3382.5217626     total: 280ms    remaining: 6.08s
44:     learn: 3346.6187868     total: 281ms    remaining: 5.97s
45:     learn: 3308.6685526     total: 284ms    remaining: 5.88s
46:     learn: 3271.0243398     total: 287ms    remaining: 5.82s
47:     learn: 3237.1722132     total: 289ms    remaining: 5.73s
48:     learn: 3208.2909468     total: 291ms    remaining: 5.65s
49:     learn: 3182.4122620     total: 293ms    remaining: 5.57s
50:     learn: 3155.1918559     total: 295ms    remaining: 5.5s
51:     learn: 3129.2658800     total: 298ms    remaining: 5.42s
52:     learn: 3104.1345516     total: 301ms    remaining: 5.37s
53:     learn: 3082.9645226     total: 304ms    remaining: 5.33s
54:     learn: 3061.4791486     total: 307ms    remaining: 5.27s
55:     learn: 3041.7711475     total: 309ms    remaining: 5.21s
56:     learn: 3023.8552921     total: 312ms    remaining: 5.16s
57:     learn: 3007.4721660     total: 316ms    remaining: 5.13s
58:     learn: 2989.7896784     total: 318ms    remaining: 5.07s
59:     learn: 2975.1351258     total: 321ms    remaining: 5.03s
60:     learn: 2961.5984092     total: 323ms    remaining: 4.97s
61:     learn: 2946.4956982     total: 326ms    remaining: 4.94s
62:     learn: 2934.4971353     total: 329ms    remaining: 4.89s
```

```
63:     learn: 2922.6169477     total: 331ms    remaining: 4.84s
64:     learn: 2909.5237915     total: 333ms    remaining: 4.79s
65:     learn: 2899.2032969     total: 335ms    remaining: 4.75s
66:     learn: 2887.1568411     total: 338ms    remaining: 4.7s
67:     learn: 2876.3541446     total: 340ms    remaining: 4.66s
68:     learn: 2866.4469630     total: 344ms    remaining: 4.64s
69:     learn: 2856.0406557     total: 347ms    remaining: 4.61s
70:     learn: 2845.0700534     total: 350ms    remaining: 4.58s
71:     learn: 2837.5108404     total: 353ms    remaining: 4.55s
72:     learn: 2828.7128737     total: 356ms    remaining: 4.51s
73:     learn: 2819.6089934     total: 359ms    remaining: 4.49s
74:     learn: 2812.3151370     total: 362ms    remaining: 4.46s
75:     learn: 2805.4509788     total: 364ms    remaining: 4.42s
76:     learn: 2797.6399756     total: 368ms    remaining: 4.41s
77:     learn: 2791.6144715     total: 370ms    remaining: 4.38s
78:     learn: 2784.2715688     total: 373ms    remaining: 4.35s
79:     learn: 2778.1001303     total: 376ms    remaining: 4.32s
80:     learn: 2769.5134553     total: 378ms    remaining: 4.29s
81:     learn: 2765.1714429     total: 381ms    remaining: 4.26s
82:     learn: 2760.0864215     total: 383ms    remaining: 4.24s
83:     learn: 2755.3813402     total: 385ms    remaining: 4.2s
84:     learn: 2746.4768284     total: 388ms    remaining: 4.17s
85:     learn: 2738.4391100     total: 390ms    remaining: 4.14s
86:     learn: 2731.4930552     total: 393ms    remaining: 4.12s
87:     learn: 2726.8844348     total: 396ms    remaining: 4.1s
88:     learn: 2719.5587785     total: 398ms    remaining: 4.08s
89:     learn: 2712.8541270     total: 400ms    remaining: 4.05s
90:     learn: 2709.2863640     total: 402ms    remaining: 4.02s
91:     learn: 2705.4575934     total: 404ms    remaining: 3.99s
92:     learn: 2702.6505662     total: 406ms    remaining: 3.96s
93:     learn: 2699.5699004     total: 408ms    remaining: 3.93s
94:     learn: 2692.0087107     total: 410ms    remaining: 3.91s
95:     learn: 2685.3805336     total: 412ms    remaining: 3.88s
96:     learn: 2680.7077044     total: 414ms    remaining: 3.85s
97:     learn: 2677.1229620     total: 416ms    remaining: 3.83s
98:     learn: 2672.5539943     total: 418ms    remaining: 3.81s
99:     learn: 2666.8566457     total: 420ms    remaining: 3.78s
100:    learn: 2663.7617500     total: 422ms    remaining: 3.76s
101:    learn: 2659.7493117     total: 424ms    remaining: 3.74s
102:    learn: 2653.0498472     total: 426ms    remaining: 3.71s
103:    learn: 2645.8658418     total: 428ms    remaining: 3.69s
104:    learn: 2642.6533410     total: 430ms    remaining: 3.67s
105:    learn: 2639.9753437     total: 432ms    remaining: 3.64s
106:    learn: 2637.0771256     total: 434ms    remaining: 3.62s
107:    learn: 2633.6019489     total: 436ms    remaining: 3.6s
108:    learn: 2631.5618875     total: 438ms    remaining: 3.58s
109:    learn: 2628.3702902     total: 440ms    remaining: 3.56s
110:    learn: 2624.6906291     total: 441ms    remaining: 3.54s
111:    learn: 2622.8591124     total: 443ms    remaining: 3.51s
112:    learn: 2621.0871988     total: 445ms    remaining: 3.49s
113:    learn: 2614.0259263     total: 447ms    remaining: 3.47s
114:    learn: 2608.6447150     total: 449ms    remaining: 3.46s
115:    learn: 2602.8198049     total: 451ms    remaining: 3.44s
116:    learn: 2600.2064995     total: 453ms    remaining: 3.42s
117:    learn: 2597.5957311     total: 455ms    remaining: 3.4s
118:    learn: 2595.8072842     total: 457ms    remaining: 3.38s
119:    learn: 2589.3979239     total: 459ms    remaining: 3.37s
120:    learn: 2582.6077701     total: 461ms    remaining: 3.35s
121:    learn: 2580.0319824     total: 463ms    remaining: 3.33s
122:    learn: 2574.3420593     total: 465ms    remaining: 3.31s
123:    learn: 2572.9840937     total: 467ms    remaining: 3.3s
124:    learn: 2570.7837510     total: 469ms    remaining: 3.28s
125:    learn: 2569.1284453     total: 471ms    remaining: 3.27s
126:    learn: 2566.7985694     total: 473ms    remaining: 3.25s
```

```
127:    learn: 2563.7051841     total: 475ms    remaining: 3.24s
128:    learn: 2561.7762209     total: 477ms    remaining: 3.22s
129:    learn: 2555.5619127     total: 479ms    remaining: 3.21s
130:    learn: 2551.8394605     total: 481ms    remaining: 3.19s
131:    learn: 2550.3776597     total: 483ms    remaining: 3.17s
132:    learn: 2549.1107696     total: 485ms    remaining: 3.16s
133:    learn: 2547.8422500     total: 487ms    remaining: 3.15s
134:    learn: 2544.3480548     total: 489ms    remaining: 3.13s
135:    learn: 2538.0608478     total: 491ms    remaining: 3.12s
136:    learn: 2532.6442614     total: 493ms    remaining: 3.11s
137:    learn: 2528.9721065     total: 495ms    remaining: 3.09s
138:    learn: 2527.9116493     total: 497ms    remaining: 3.08s
139:    learn: 2524.2438303     total: 499ms    remaining: 3.06s
140:    learn: 2515.7721911     total: 501ms    remaining: 3.05s
141:    learn: 2514.3084712     total: 503ms    remaining: 3.04s
142:    learn: 2513.1533890     total: 505ms    remaining: 3.02s
143:    learn: 2509.5452805     total: 507ms    remaining: 3.01s
144:    learn: 2508.4461831     total: 509ms    remaining: 3s
145:    learn: 2506.6198860     total: 511ms    remaining: 2.99s
146:    learn: 2504.9337095     total: 513ms    remaining: 2.98s
147:    learn: 2503.4175458     total: 515ms    remaining: 2.96s
148:    learn: 2500.5900739     total: 517ms    remaining: 2.95s
149:    learn: 2498.4943086     total: 519ms    remaining: 2.94s
150:    learn: 2496.7285108     total: 521ms    remaining: 2.93s
151:    learn: 2494.9413175     total: 523ms    remaining: 2.92s
152:    learn: 2490.7963672     total: 525ms    remaining: 2.91s
153:    learn: 2485.5570750     total: 527ms    remaining: 2.9s
154:    learn: 2480.0130207     total: 531ms    remaining: 2.9s
155:    learn: 2476.9233044     total: 534ms    remaining: 2.89s
156:    learn: 2473.0096184     total: 536ms    remaining: 2.88s
157:    learn: 2469.3720030     total: 538ms    remaining: 2.87s
158:    learn: 2467.0666985     total: 540ms    remaining: 2.86s
159:    learn: 2462.8936649     total: 542ms    remaining: 2.85s
160:    learn: 2461.7735823     total: 544ms    remaining: 2.84s
161:    learn: 2457.8375206     total: 547ms    remaining: 2.83s
162:    learn: 2456.7774149     total: 549ms    remaining: 2.82s
163:    learn: 2451.8195497     total: 552ms    remaining: 2.81s
164:    learn: 2450.1472079     total: 554ms    remaining: 2.8s
165:    learn: 2448.0529765     total: 556ms    remaining: 2.79s
166:    learn: 2446.7456460     total: 559ms    remaining: 2.79s
167:    learn: 2443.4751460     total: 562ms    remaining: 2.78s
168:    learn: 2441.6903977     total: 563ms    remaining: 2.77s
169:    learn: 2438.2389466     total: 566ms    remaining: 2.77s
170:    learn: 2435.7322442     total: 568ms    remaining: 2.75s
171:    learn: 2431.2910792     total: 571ms    remaining: 2.75s
172:    learn: 2426.6261530     total: 573ms    remaining: 2.74s
173:    learn: 2422.9463040     total: 576ms    remaining: 2.73s
174:    learn: 2419.9353287     total: 578ms    remaining: 2.72s
175:    learn: 2414.7515895     total: 580ms    remaining: 2.71s
176:    learn: 2411.1399704     total: 582ms    remaining: 2.71s
177:    learn: 2407.3975670     total: 584ms    remaining: 2.7s
178:    learn: 2403.8029813     total: 586ms    remaining: 2.69s
179:    learn: 2401.9238572     total: 588ms    remaining: 2.68s
180:    learn: 2401.1810990     total: 590ms    remaining: 2.67s
181:    learn: 2398.9784247     total: 592ms    remaining: 2.66s
182:    learn: 2394.6981931     total: 594ms    remaining: 2.65s
183:    learn: 2393.7228790     total: 596ms    remaining: 2.64s
184:    learn: 2389.4316998     total: 598ms    remaining: 2.63s
185:    learn: 2387.3219883     total: 600ms    remaining: 2.62s
186:    learn: 2383.4594785     total: 601ms    remaining: 2.61s
187:    learn: 2381.4905592     total: 604ms    remaining: 2.61s
188:    learn: 2379.4766234     total: 606ms    remaining: 2.6s
189:    learn: 2376.5627657     total: 608ms    remaining: 2.59s
190:    learn: 2375.5719527     total: 610ms    remaining: 2.58s
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191:    learn: 2374.3295673     total: 612ms    remaining: 2.58s
192:    learn: 2372.4417060     total: 614ms    remaining: 2.57s
193:    learn: 2369.0176928     total: 617ms    remaining: 2.56s
194:    learn: 2364.3244967     total: 620ms    remaining: 2.56s
195:    learn: 2361.6343440     total: 622ms    remaining: 2.55s
196:    learn: 2359.9465405     total: 625ms    remaining: 2.55s
197:    learn: 2356.5761203     total: 628ms    remaining: 2.54s
198:    learn: 2352.8972492     total: 630ms    remaining: 2.54s
199:    learn: 2351.3091709     total: 633ms    remaining: 2.53s
200:    learn: 2348.8287081     total: 635ms    remaining: 2.53s
201:    learn: 2344.7223111     total: 638ms    remaining: 2.52s
202:    learn: 2341.8979799     total: 641ms    remaining: 2.52s
203:    learn: 2339.3834400     total: 643ms    remaining: 2.51s
204:    learn: 2336.7397791     total: 645ms    remaining: 2.5s
205:    learn: 2332.7341946     total: 648ms    remaining: 2.5s
206:    learn: 2331.1570339     total: 650ms    remaining: 2.49s
207:    learn: 2330.1469053     total: 652ms    remaining: 2.48s
208:    learn: 2328.5048551     total: 654ms    remaining: 2.48s
209:    learn: 2325.8042229     total: 656ms    remaining: 2.47s
210:    learn: 2323.1827586     total: 658ms    remaining: 2.46s
211:    learn: 2321.8507437     total: 660ms    remaining: 2.45s
212:    learn: 2319.4615125     total: 664ms    remaining: 2.45s
213:    learn: 2317.9953685     total: 667ms    remaining: 2.45s
214:    learn: 2313.8653443     total: 669ms    remaining: 2.44s
215:    learn: 2311.6666976     total: 672ms    remaining: 2.44s
216:    learn: 2310.8628416     total: 674ms    remaining: 2.43s
217:    learn: 2308.5713992     total: 676ms    remaining: 2.43s
218:    learn: 2306.1372012     total: 679ms    remaining: 2.42s
219:    learn: 2302.0062648     total: 682ms    remaining: 2.42s
220:    learn: 2300.0201361     total: 684ms    remaining: 2.41s
221:    learn: 2299.3623804     total: 687ms    remaining: 2.41s
222:    learn: 2297.4866455     total: 689ms    remaining: 2.4s
223:    learn: 2296.1367228     total: 692ms    remaining: 2.4s
224:    learn: 2295.3638728     total: 694ms    remaining: 2.39s
225:    learn: 2292.2081711     total: 696ms    remaining: 2.38s
226:    learn: 2291.0705003     total: 699ms    remaining: 2.38s
227:    learn: 2290.3601510     total: 702ms    remaining: 2.38s
228:    learn: 2288.4066963     total: 705ms    remaining: 2.37s
229:    learn: 2286.8999710     total: 707ms    remaining: 2.37s
230:    learn: 2284.6968680     total: 709ms    remaining: 2.36s
231:    learn: 2280.6036096     total: 711ms    remaining: 2.35s
232:    learn: 2277.7166165     total: 713ms    remaining: 2.35s
233:    learn: 2276.4278465     total: 716ms    remaining: 2.34s
234:    learn: 2273.6209241     total: 718ms    remaining: 2.34s
235:    learn: 2272.0204831     total: 721ms    remaining: 2.33s
236:    learn: 2270.6933912     total: 724ms    remaining: 2.33s
237:    learn: 2269.2872633     total: 726ms    remaining: 2.32s
238:    learn: 2268.6510378     total: 728ms    remaining: 2.32s
239:    learn: 2267.7382506     total: 731ms    remaining: 2.31s
240:    learn: 2266.5191942     total: 734ms    remaining: 2.31s
241:    learn: 2263.8184607     total: 737ms    remaining: 2.31s
242:    learn: 2260.8971108     total: 740ms    remaining: 2.3s
243:    learn: 2257.8961388     total: 742ms    remaining: 2.3s
244:    learn: 2255.1142200     total: 746ms    remaining: 2.3s
245:    learn: 2253.3375271     total: 749ms    remaining: 2.29s
246:    learn: 2252.1520615     total: 752ms    remaining: 2.29s
247:    learn: 2250.8773180     total: 756ms    remaining: 2.29s
248:    learn: 2248.9366056     total: 759ms    remaining: 2.29s
249:    learn: 2247.8539535     total: 762ms    remaining: 2.28s
250:    learn: 2245.5452126     total: 764ms    remaining: 2.28s
251:    learn: 2243.6079580     total: 766ms    remaining: 2.27s
252:    learn: 2243.0677413     total: 769ms    remaining: 2.27s
253:    learn: 2241.2410885     total: 772ms    remaining: 2.27s
254:    learn: 2239.5703821     total: 774ms    remaining: 2.26s
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255:    learn: 2239.0536195     total: 777ms    remaining: 2.26s
256:    learn: 2237.0661750     total: 781ms    remaining: 2.26s
257:    learn: 2234.3419690     total: 785ms    remaining: 2.26s
258:    learn: 2233.2599903     total: 788ms    remaining: 2.25s
259:    learn: 2232.1035603     total: 790ms    remaining: 2.25s
260:    learn: 2230.3597870     total: 793ms    remaining: 2.24s
261:    learn: 2228.8223107     total: 796ms    remaining: 2.24s
262:    learn: 2227.7321883     total: 799ms    remaining: 2.24s
263:    learn: 2224.9135683     total: 803ms    remaining: 2.24s
264:    learn: 2222.5932244     total: 805ms    remaining: 2.23s
265:    learn: 2221.3033874     total: 808ms    remaining: 2.23s
266:    learn: 2218.9989089     total: 811ms    remaining: 2.23s
267:    learn: 2218.0565399     total: 814ms    remaining: 2.22s
268:    learn: 2216.0659146     total: 817ms    remaining: 2.22s
269:    learn: 2215.2379015     total: 820ms    remaining: 2.22s
270:    learn: 2214.3929080     total: 823ms    remaining: 2.21s
271:    learn: 2212.7617027     total: 826ms    remaining: 2.21s
272:    learn: 2211.3943208     total: 829ms    remaining: 2.21s
273:    learn: 2209.5978040     total: 831ms    remaining: 2.2s
274:    learn: 2208.2834195     total: 834ms    remaining: 2.2s
275:    learn: 2205.9491455     total: 836ms    remaining: 2.19s
276:    learn: 2204.3367314     total: 839ms    remaining: 2.19s
277:    learn: 2203.3437888     total: 841ms    remaining: 2.19s
278:    learn: 2201.9295436     total: 845ms    remaining: 2.18s
279:    learn: 2201.3682357     total: 847ms    remaining: 2.18s
280:    learn: 2199.6851698     total: 850ms    remaining: 2.17s
281:    learn: 2198.4513806     total: 853ms    remaining: 2.17s
282:    learn: 2196.5759198     total: 856ms    remaining: 2.17s
283:    learn: 2195.2487722     total: 859ms    remaining: 2.17s
284:    learn: 2193.4327532     total: 862ms    remaining: 2.16s
285:    learn: 2192.4811988     total: 866ms    remaining: 2.16s
286:    learn: 2191.1121062     total: 869ms    remaining: 2.16s
287:    learn: 2189.6346085     total: 873ms    remaining: 2.16s
288:    learn: 2189.0524662     total: 876ms    remaining: 2.15s
289:    learn: 2187.8812063     total: 879ms    remaining: 2.15s
290:    learn: 2186.4666399     total: 882ms    remaining: 2.15s
291:    learn: 2185.8212225     total: 885ms    remaining: 2.15s
292:    learn: 2184.3760048     total: 888ms    remaining: 2.14s
293:    learn: 2183.1951233     total: 890ms    remaining: 2.14s
294:    learn: 2182.3017489     total: 893ms    remaining: 2.13s
295:    learn: 2180.3024496     total: 896ms    remaining: 2.13s
296:    learn: 2177.9426616     total: 898ms    remaining: 2.13s
297:    learn: 2177.3601388     total: 900ms    remaining: 2.12s
298:    learn: 2175.6599236     total: 903ms    remaining: 2.12s
299:    learn: 2172.9605772     total: 905ms    remaining: 2.11s
300:    learn: 2170.7213505     total: 907ms    remaining: 2.1s
301:    learn: 2168.6544922     total: 909ms    remaining: 2.1s
302:    learn: 2167.1275755     total: 911ms    remaining: 2.1s
303:    learn: 2166.0826116     total: 914ms    remaining: 2.09s
304:    learn: 2163.2943611     total: 915ms    remaining: 2.08s
305:    learn: 2162.5521283     total: 918ms    remaining: 2.08s
306:    learn: 2161.7195792     total: 921ms    remaining: 2.08s
307:    learn: 2159.1246119     total: 923ms    remaining: 2.07s
308:    learn: 2157.8115214     total: 925ms    remaining: 2.07s
309:    learn: 2156.7323516     total: 928ms    remaining: 2.06s
310:    learn: 2156.3794451     total: 930ms    remaining: 2.06s
311:    learn: 2154.6954939     total: 933ms    remaining: 2.06s
312:    learn: 2153.3721023     total: 937ms    remaining: 2.06s
313:    learn: 2152.5580230     total: 940ms    remaining: 2.05s
314:    learn: 2150.7739401     total: 942ms    remaining: 2.05s
315:    learn: 2148.9524892     total: 945ms    remaining: 2.05s
316:    learn: 2146.9666217     total: 948ms    remaining: 2.04s
317:    learn: 2146.2137458     total: 952ms    remaining: 2.04s
318:    learn: 2145.3837690     total: 956ms    remaining: 2.04s
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319:    learn: 2143.6900342     total: 959ms    remaining: 2.04s
320:    learn: 2143.1073984     total: 963ms    remaining: 2.04s
321:    learn: 2141.2489214     total: 966ms    remaining: 2.03s
322:    learn: 2138.7507477     total: 969ms    remaining: 2.03s
323:    learn: 2138.2944944     total: 972ms    remaining: 2.03s
324:    learn: 2137.2489100     total: 975ms    remaining: 2.02s
325:    learn: 2134.9212607     total: 977ms    remaining: 2.02s
326:    learn: 2133.1781500     total: 979ms    remaining: 2.02s
327:    learn: 2132.8752263     total: 982ms    remaining: 2.01s
328:    learn: 2131.1601077     total: 985ms    remaining: 2.01s
329:    learn: 2130.2683165     total: 989ms    remaining: 2.01s
330:    learn: 2128.7245429     total: 992ms    remaining: 2s
331:    learn: 2127.5532970     total: 994ms    remaining: 2s
332:    learn: 2125.4573785     total: 997ms    remaining: 2s
333:    learn: 2124.5381941     total: 1000ms   remaining: 1.99s
334:    learn: 2122.6311581     total: 1s       remaining: 1.99s
335:    learn: 2121.4527062     total: 1s       remaining: 1.99s
336:    learn: 2120.8766038     total: 1.01s    remaining: 1.98s
337:    learn: 2119.2143619     total: 1.01s    remaining: 1.98s
338:    learn: 2117.3574543     total: 1.01s    remaining: 1.98s
339:    learn: 2115.8275436     total: 1.02s    remaining: 1.97s
340:    learn: 2114.0461826     total: 1.02s    remaining: 1.97s
341:    learn: 2113.2203748     total: 1.02s    remaining: 1.97s
342:    learn: 2112.7480788     total: 1.02s    remaining: 1.96s
343:    learn: 2112.2858156     total: 1.03s    remaining: 1.96s
344:    learn: 2111.8071095     total: 1.03s    remaining: 1.96s
345:    learn: 2110.3162373     total: 1.03s    remaining: 1.96s
346:    learn: 2108.7881291     total: 1.04s    remaining: 1.95s
347:    learn: 2107.8295075     total: 1.04s    remaining: 1.95s
348:    learn: 2106.1971944     total: 1.04s    remaining: 1.95s
349:    learn: 2105.0772561     total: 1.05s    remaining: 1.95s
350:    learn: 2103.0385077     total: 1.05s    remaining: 1.94s
351:    learn: 2102.2267748     total: 1.05s    remaining: 1.94s
352:    learn: 2101.5939679     total: 1.06s    remaining: 1.94s
353:    learn: 2100.9065119     total: 1.06s    remaining: 1.94s
354:    learn: 2099.5373624     total: 1.07s    remaining: 1.94s
355:    learn: 2098.5322289     total: 1.07s    remaining: 1.94s
356:    learn: 2097.5121775     total: 1.07s    remaining: 1.93s
357:    learn: 2095.7581053     total: 1.07s    remaining: 1.93s
358:    learn: 2095.1361019     total: 1.08s    remaining: 1.93s
359:    learn: 2093.7142976     total: 1.08s    remaining: 1.92s
360:    learn: 2093.3413990     total: 1.08s    remaining: 1.92s
361:    learn: 2091.7515107     total: 1.09s    remaining: 1.92s
362:    learn: 2091.0042300     total: 1.09s    remaining: 1.92s
363:    learn: 2090.1564930     total: 1.09s    remaining: 1.91s
364:    learn: 2088.6981004     total: 1.1s     remaining: 1.91s
365:    learn: 2087.8863928     total: 1.1s     remaining: 1.9s
366:    learn: 2086.1502006     total: 1.1s     remaining: 1.9s
367:    learn: 2085.7305074     total: 1.1s     remaining: 1.9s
368:    learn: 2084.2999506     total: 1.11s    remaining: 1.89s
369:    learn: 2083.5689399     total: 1.11s    remaining: 1.89s
370:    learn: 2082.7006434     total: 1.11s    remaining: 1.88s
371:    learn: 2081.0523383     total: 1.11s    remaining: 1.88s
372:    learn: 2079.6112870     total: 1.11s    remaining: 1.87s
373:    learn: 2078.6238419     total: 1.12s    remaining: 1.87s
374:    learn: 2077.8048389     total: 1.12s    remaining: 1.87s
375:    learn: 2077.3209840     total: 1.12s    remaining: 1.86s
376:    learn: 2075.9234932     total: 1.13s    remaining: 1.86s
377:    learn: 2075.0982395     total: 1.13s    remaining: 1.86s
378:    learn: 2073.7818651     total: 1.13s    remaining: 1.85s
379:    learn: 2072.5447603     total: 1.13s    remaining: 1.85s
380:    learn: 2071.4406247     total: 1.14s    remaining: 1.85s
381:    learn: 2070.3950254     total: 1.14s    remaining: 1.84s
382:    learn: 2069.6407734     total: 1.14s    remaining: 1.84s
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383:    learn: 2068.7295065     total: 1.14s    remaining: 1.84s
384:    learn: 2068.3441787     total: 1.15s    remaining: 1.83s
385:    learn: 2066.7364328     total: 1.15s    remaining: 1.83s
386:    learn: 2065.0185994     total: 1.15s    remaining: 1.82s
387:    learn: 2064.6304886     total: 1.15s    remaining: 1.82s
388:    learn: 2063.7416718     total: 1.16s    remaining: 1.82s
389:    learn: 2063.1126376     total: 1.16s    remaining: 1.81s
390:    learn: 2061.5501036     total: 1.16s    remaining: 1.81s
391:    learn: 2060.6487557     total: 1.16s    remaining: 1.8s
392:    learn: 2060.0244989     total: 1.17s    remaining: 1.8s
393:    learn: 2059.6385365     total: 1.17s    remaining: 1.8s
394:    learn: 2059.2519356     total: 1.17s    remaining: 1.79s
395:    learn: 2058.9871777     total: 1.17s    remaining: 1.79s
396:    learn: 2058.3425531     total: 1.18s    remaining: 1.79s
397:    learn: 2057.2968809     total: 1.18s    remaining: 1.78s
398:    learn: 2055.9663284     total: 1.18s    remaining: 1.78s
399:    learn: 2055.6215885     total: 1.18s    remaining: 1.78s
400:    learn: 2053.7417132     total: 1.19s    remaining: 1.77s
401:    learn: 2053.1727530     total: 1.19s    remaining: 1.77s
402:    learn: 2052.9161006     total: 1.19s    remaining: 1.77s
403:    learn: 2052.5791741     total: 1.2s     remaining: 1.76s
404:    learn: 2051.6167365     total: 1.2s     remaining: 1.76s
405:    learn: 2051.1942573     total: 1.2s     remaining: 1.76s
406:    learn: 2050.0677724     total: 1.21s    remaining: 1.76s
407:    learn: 2049.3439759     total: 1.21s    remaining: 1.75s
408:    learn: 2047.9810116     total: 1.21s    remaining: 1.75s
409:    learn: 2047.4575804     total: 1.22s    remaining: 1.75s
410:    learn: 2045.8249964     total: 1.22s    remaining: 1.75s
411:    learn: 2044.8905244     total: 1.23s    remaining: 1.75s
412:    learn: 2044.2624192     total: 1.23s    remaining: 1.75s
413:    learn: 2043.1550900     total: 1.23s    remaining: 1.75s
414:    learn: 2042.0421938     total: 1.24s    remaining: 1.75s
415:    learn: 2040.5813948     total: 1.24s    remaining: 1.74s
416:    learn: 2040.0281646     total: 1.25s    remaining: 1.74s
417:    learn: 2039.5287786     total: 1.25s    remaining: 1.74s
418:    learn: 2038.5020074     total: 1.25s    remaining: 1.74s
419:    learn: 2038.0927268     total: 1.26s    remaining: 1.74s
420:    learn: 2037.4093787     total: 1.26s    remaining: 1.74s
421:    learn: 2036.1485940     total: 1.27s    remaining: 1.74s
422:    learn: 2034.7226603     total: 1.27s    remaining: 1.73s
423:    learn: 2033.5707482     total: 1.28s    remaining: 1.73s
424:    learn: 2033.0383672     total: 1.28s    remaining: 1.73s
425:    learn: 2031.8496759     total: 1.28s    remaining: 1.73s
426:    learn: 2031.5409736     total: 1.29s    remaining: 1.73s
427:    learn: 2031.0502696     total: 1.29s    remaining: 1.73s
428:    learn: 2029.8826234     total: 1.3s     remaining: 1.73s
429:    learn: 2029.0223285     total: 1.3s     remaining: 1.73s
430:    learn: 2028.6691458     total: 1.3s     remaining: 1.72s
431:    learn: 2027.5892395     total: 1.31s    remaining: 1.72s
432:    learn: 2027.0877877     total: 1.31s    remaining: 1.72s
433:    learn: 2026.6111725     total: 1.32s    remaining: 1.72s
434:    learn: 2025.2018087     total: 1.32s    remaining: 1.72s
435:    learn: 2024.2853461     total: 1.33s    remaining: 1.72s
436:    learn: 2022.8013427     total: 1.33s    remaining: 1.72s
437:    learn: 2021.5631148     total: 1.33s    remaining: 1.71s
438:    learn: 2020.3064326     total: 1.34s    remaining: 1.71s
439:    learn: 2019.6452712     total: 1.34s    remaining: 1.71s
440:    learn: 2018.9094671     total: 1.35s    remaining: 1.71s
441:    learn: 2018.4999118     total: 1.35s    remaining: 1.7s
442:    learn: 2017.3408730     total: 1.35s    remaining: 1.7s
443:    learn: 2016.6759068     total: 1.36s    remaining: 1.7s
444:    learn: 2016.2032522     total: 1.36s    remaining: 1.7s
445:    learn: 2015.7219803     total: 1.36s    remaining: 1.69s
446:    learn: 2014.5412531     total: 1.36s    remaining: 1.69s
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447:    learn: 2013.9899293     total: 1.37s    remaining: 1.69s
448:    learn: 2012.8931414     total: 1.37s    remaining: 1.68s
449:    learn: 2012.1990400     total: 1.37s    remaining: 1.68s
450:    learn: 2011.9768527     total: 1.38s    remaining: 1.68s
451:    learn: 2011.1572786     total: 1.38s    remaining: 1.67s
452:    learn: 2010.4227179     total: 1.38s    remaining: 1.67s
453:    learn: 2009.1639786     total: 1.39s    remaining: 1.67s
454:    learn: 2008.2453620     total: 1.39s    remaining: 1.67s
455:    learn: 2007.1229891     total: 1.39s    remaining: 1.66s
456:    learn: 2006.4868494     total: 1.4s     remaining: 1.66s
457:    learn: 2005.9297177     total: 1.4s     remaining: 1.66s
458:    learn: 2005.1118862     total: 1.4s     remaining: 1.65s
459:    learn: 2003.9253759     total: 1.41s    remaining: 1.65s
460:    learn: 2003.0787007     total: 1.41s    remaining: 1.65s
461:    learn: 2002.1593653     total: 1.41s    remaining: 1.64s
462:    learn: 2001.0003654     total: 1.41s    remaining: 1.64s
463:    learn: 2000.3917919     total: 1.42s    remaining: 1.64s
464:    learn: 1999.7286243     total: 1.42s    remaining: 1.63s
465:    learn: 1999.4090085     total: 1.42s    remaining: 1.63s
466:    learn: 1997.7193686     total: 1.43s    remaining: 1.63s
467:    learn: 1996.9725857     total: 1.43s    remaining: 1.62s
468:    learn: 1996.5072101     total: 1.43s    remaining: 1.62s
469:    learn: 1995.7888966     total: 1.43s    remaining: 1.62s
470:    learn: 1994.9640772     total: 1.44s    remaining: 1.61s
471:    learn: 1994.4350314     total: 1.44s    remaining: 1.61s
472:    learn: 1993.5608808     total: 1.44s    remaining: 1.61s
473:    learn: 1993.2499968     total: 1.44s    remaining: 1.6s
474:    learn: 1992.7471621     total: 1.45s    remaining: 1.6s
475:    learn: 1992.2475564     total: 1.45s    remaining: 1.59s
476:    learn: 1991.7628709     total: 1.45s    remaining: 1.59s
477:    learn: 1991.2956387     total: 1.45s    remaining: 1.59s
478:    learn: 1990.6423896     total: 1.46s    remaining: 1.58s
479:    learn: 1989.5627741     total: 1.46s    remaining: 1.58s
480:    learn: 1989.1013632     total: 1.46s    remaining: 1.58s
481:    learn: 1987.5327571     total: 1.47s    remaining: 1.57s
482:    learn: 1986.7697006     total: 1.47s    remaining: 1.57s
483:    learn: 1986.1974450     total: 1.47s    remaining: 1.57s
484:    learn: 1985.2166998     total: 1.48s    remaining: 1.57s
485:    learn: 1984.6167709     total: 1.48s    remaining: 1.56s
486:    learn: 1983.6286287     total: 1.48s    remaining: 1.56s
487:    learn: 1982.9099774     total: 1.49s    remaining: 1.56s
488:    learn: 1981.9968499     total: 1.49s    remaining: 1.56s
489:    learn: 1981.7712767     total: 1.49s    remaining: 1.55s
490:    learn: 1981.3585417     total: 1.5s     remaining: 1.55s
491:    learn: 1980.5637465     total: 1.5s     remaining: 1.55s
492:    learn: 1979.7976352     total: 1.5s     remaining: 1.54s
493:    learn: 1979.0367149     total: 1.51s    remaining: 1.54s
494:    learn: 1978.6211400     total: 1.51s    remaining: 1.54s
495:    learn: 1977.4294842     total: 1.51s    remaining: 1.54s
496:    learn: 1977.1983317     total: 1.51s    remaining: 1.53s
497:    learn: 1976.5265970     total: 1.52s    remaining: 1.53s
498:    learn: 1976.2639950     total: 1.52s    remaining: 1.52s
499:    learn: 1975.6494886     total: 1.52s    remaining: 1.52s
500:    learn: 1975.4657200     total: 1.52s    remaining: 1.52s
501:    learn: 1974.6613548     total: 1.53s    remaining: 1.51s
502:    learn: 1973.9763726     total: 1.53s    remaining: 1.51s
503:    learn: 1973.0045530     total: 1.53s    remaining: 1.51s
504:    learn: 1972.2586554     total: 1.53s    remaining: 1.5s
505:    learn: 1971.4346339     total: 1.54s    remaining: 1.5s
506:    learn: 1971.0338105     total: 1.54s    remaining: 1.5s
507:    learn: 1970.1037573     total: 1.54s    remaining: 1.49s
508:    learn: 1969.7541908     total: 1.54s    remaining: 1.49s
509:    learn: 1968.5974607     total: 1.55s    remaining: 1.49s
510:    learn: 1967.8594637     total: 1.55s    remaining: 1.48s
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511:    learn: 1967.4950155     total: 1.55s    remaining: 1.48s
512:    learn: 1967.0103694     total: 1.56s    remaining: 1.48s
513:    learn: 1966.6437177     total: 1.56s    remaining: 1.48s
514:    learn: 1965.9181629     total: 1.56s    remaining: 1.47s
515:    learn: 1965.0678241     total: 1.57s    remaining: 1.47s
516:    learn: 1964.5608379     total: 1.57s    remaining: 1.47s
517:    learn: 1963.2465673     total: 1.57s    remaining: 1.46s
518:    learn: 1963.0037246     total: 1.58s    remaining: 1.46s
519:    learn: 1962.5039594     total: 1.58s    remaining: 1.46s
520:    learn: 1962.0345888     total: 1.58s    remaining: 1.45s
521:    learn: 1961.4558941     total: 1.58s    remaining: 1.45s
522:    learn: 1960.6682949     total: 1.59s    remaining: 1.45s
523:    learn: 1960.3780272     total: 1.59s    remaining: 1.45s
524:    learn: 1958.8281483     total: 1.59s    remaining: 1.44s
525:    learn: 1958.5732142     total: 1.6s     remaining: 1.44s
526:    learn: 1957.9611374     total: 1.6s     remaining: 1.44s
527:    learn: 1957.5332856     total: 1.6s     remaining: 1.43s
528:    learn: 1957.2970912     total: 1.61s    remaining: 1.43s
529:    learn: 1956.9048088     total: 1.61s    remaining: 1.43s
530:    learn: 1956.6184788     total: 1.61s    remaining: 1.42s
531:    learn: 1955.6678954     total: 1.61s    remaining: 1.42s
532:    learn: 1954.9135545     total: 1.62s    remaining: 1.42s
533:    learn: 1953.8750021     total: 1.62s    remaining: 1.41s
534:    learn: 1953.4965275     total: 1.62s    remaining: 1.41s
535:    learn: 1952.5737533     total: 1.63s    remaining: 1.41s
536:    learn: 1952.0263387     total: 1.63s    remaining: 1.4s
537:    learn: 1951.2120382     total: 1.63s    remaining: 1.4s
538:    learn: 1950.2382556     total: 1.64s    remaining: 1.4s
539:    learn: 1949.6131706     total: 1.64s    remaining: 1.4s
540:    learn: 1949.0997197     total: 1.64s    remaining: 1.39s
541:    learn: 1948.6255511     total: 1.64s    remaining: 1.39s
542:    learn: 1948.3545155     total: 1.65s    remaining: 1.39s
543:    learn: 1947.7124332     total: 1.65s    remaining: 1.38s
544:    learn: 1946.7044797     total: 1.65s    remaining: 1.38s
545:    learn: 1946.3585301     total: 1.66s    remaining: 1.38s
546:    learn: 1945.8879043     total: 1.66s    remaining: 1.37s
547:    learn: 1945.4443258     total: 1.66s    remaining: 1.37s
548:    learn: 1944.6846793     total: 1.66s    remaining: 1.37s
549:    learn: 1944.3374281     total: 1.67s    remaining: 1.36s
550:    learn: 1943.9329499     total: 1.67s    remaining: 1.36s
551:    learn: 1943.4168048     total: 1.67s    remaining: 1.35s
552:    learn: 1942.8832855     total: 1.67s    remaining: 1.35s
553:    learn: 1942.6431434     total: 1.67s    remaining: 1.35s
554:    learn: 1942.0215997     total: 1.68s    remaining: 1.34s
555:    learn: 1941.4128151     total: 1.68s    remaining: 1.34s
556:    learn: 1940.5166896     total: 1.68s    remaining: 1.34s
557:    learn: 1939.0710695     total: 1.68s    remaining: 1.33s
558:    learn: 1938.4812282     total: 1.69s    remaining: 1.33s
559:    learn: 1938.3262418     total: 1.69s    remaining: 1.33s
560:    learn: 1937.6724483     total: 1.69s    remaining: 1.32s
561:    learn: 1937.0758850     total: 1.7s     remaining: 1.32s
562:    learn: 1936.6034478     total: 1.7s     remaining: 1.32s
563:    learn: 1936.0390919     total: 1.7s     remaining: 1.32s
564:    learn: 1935.3175178     total: 1.71s    remaining: 1.31s
565:    learn: 1934.9924113     total: 1.71s    remaining: 1.31s
566:    learn: 1934.8516150     total: 1.71s    remaining: 1.31s
567:    learn: 1934.1371222     total: 1.72s    remaining: 1.3s
568:    learn: 1933.4062969     total: 1.72s    remaining: 1.3s
569:    learn: 1933.0830537     total: 1.72s    remaining: 1.3s
570:    learn: 1932.5228536     total: 1.73s    remaining: 1.3s
571:    learn: 1931.9152000     total: 1.73s    remaining: 1.29s
572:    learn: 1931.1567825     total: 1.73s    remaining: 1.29s
573:    learn: 1930.6685729     total: 1.74s    remaining: 1.29s
574:    learn: 1930.2250970     total: 1.74s    remaining: 1.29s
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575:    learn: 1929.8303952     total: 1.75s    remaining: 1.29s
576:    learn: 1929.4286110     total: 1.75s    remaining: 1.28s
577:    learn: 1929.2737393     total: 1.75s    remaining: 1.28s
578:    learn: 1929.1244695     total: 1.76s    remaining: 1.28s
579:    learn: 1928.5044243     total: 1.76s    remaining: 1.27s
580:    learn: 1928.3599754     total: 1.76s    remaining: 1.27s
581:    learn: 1927.2326556     total: 1.76s    remaining: 1.27s
582:    learn: 1927.0932342     total: 1.77s    remaining: 1.26s
583:    learn: 1926.1686647     total: 1.77s    remaining: 1.26s
584:    learn: 1925.9150793     total: 1.77s    remaining: 1.26s
585:    learn: 1925.0250243     total: 1.77s    remaining: 1.25s
586:    learn: 1924.7979103     total: 1.78s    remaining: 1.25s
587:    learn: 1924.6632270     total: 1.78s    remaining: 1.25s
588:    learn: 1924.2667673     total: 1.78s    remaining: 1.25s
589:    learn: 1923.8823434     total: 1.79s    remaining: 1.24s
590:    learn: 1922.8219935     total: 1.79s    remaining: 1.24s
591:    learn: 1922.0866261     total: 1.79s    remaining: 1.24s
592:    learn: 1921.1443534     total: 1.8s     remaining: 1.23s
593:    learn: 1920.3147794     total: 1.8s     remaining: 1.23s
594:    learn: 1919.2665092     total: 1.8s     remaining: 1.23s
595:    learn: 1918.6732405     total: 1.8s     remaining: 1.22s
596:    learn: 1918.4012419     total: 1.81s    remaining: 1.22s
597:    learn: 1917.5795464     total: 1.81s    remaining: 1.22s
598:    learn: 1917.4498545     total: 1.81s    remaining: 1.21s
599:    learn: 1916.6191037     total: 1.81s    remaining: 1.21s
600:    learn: 1916.1862891     total: 1.82s    remaining: 1.21s
601:    learn: 1915.9362610     total: 1.82s    remaining: 1.2s
602:    learn: 1915.4443194     total: 1.82s    remaining: 1.2s
603:    learn: 1915.1176589     total: 1.83s    remaining: 1.2s
604:    learn: 1914.5159126     total: 1.83s    remaining: 1.2s
605:    learn: 1913.9827806     total: 1.83s    remaining: 1.19s
606:    learn: 1913.3629926     total: 1.84s    remaining: 1.19s
607:    learn: 1912.4583715     total: 1.84s    remaining: 1.19s
608:    learn: 1912.0631784     total: 1.84s    remaining: 1.18s
609:    learn: 1911.1881915     total: 1.85s    remaining: 1.18s
610:    learn: 1910.6800764     total: 1.85s    remaining: 1.18s
611:    learn: 1909.7916908     total: 1.85s    remaining: 1.17s
612:    learn: 1908.9541156     total: 1.86s    remaining: 1.17s
613:    learn: 1908.2071743     total: 1.86s    remaining: 1.17s
614:    learn: 1907.8236709     total: 1.86s    remaining: 1.17s
615:    learn: 1907.2554383     total: 1.86s    remaining: 1.16s
616:    learn: 1906.7092589     total: 1.87s    remaining: 1.16s
617:    learn: 1905.9625685     total: 1.87s    remaining: 1.16s
618:    learn: 1905.2677254     total: 1.87s    remaining: 1.15s
619:    learn: 1904.7875295     total: 1.88s    remaining: 1.15s
620:    learn: 1904.1770189     total: 1.88s    remaining: 1.15s
621:    learn: 1904.0307024     total: 1.88s    remaining: 1.14s
622:    learn: 1903.9102860     total: 1.88s    remaining: 1.14s
623:    learn: 1903.3828494     total: 1.89s    remaining: 1.14s
624:    learn: 1902.3292974     total: 1.89s    remaining: 1.13s
625:    learn: 1901.6953649     total: 1.89s    remaining: 1.13s
626:    learn: 1901.0000481     total: 1.89s    remaining: 1.13s
627:    learn: 1900.5107361     total: 1.9s     remaining: 1.12s
628:    learn: 1900.2359562     total: 1.9s     remaining: 1.12s
629:    learn: 1899.9973942     total: 1.9s     remaining: 1.12s
630:    learn: 1899.8813397     total: 1.91s    remaining: 1.11s
631:    learn: 1899.1360588     total: 1.91s    remaining: 1.11s
632:    learn: 1898.3850401     total: 1.91s    remaining: 1.11s
633:    learn: 1897.6194256     total: 1.91s    remaining: 1.1s
634:    learn: 1897.4892372     total: 1.92s    remaining: 1.1s
635:    learn: 1897.0340854     total: 1.92s    remaining: 1.1s
636:    learn: 1896.5581312     total: 1.92s    remaining: 1.09s
637:    learn: 1896.0206168     total: 1.92s    remaining: 1.09s
638:    learn: 1895.8957809     total: 1.93s    remaining: 1.09s
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639:    learn: 1895.2409481     total: 1.93s    remaining: 1.08s
640:    learn: 1894.7801656     total: 1.93s    remaining: 1.08s
641:    learn: 1894.2279707     total: 1.93s    remaining: 1.08s
642:    learn: 1893.5875994     total: 1.94s    remaining: 1.07s
643:    learn: 1893.4685132     total: 1.94s    remaining: 1.07s
644:    learn: 1892.5876716     total: 1.94s    remaining: 1.07s
645:    learn: 1892.4121188     total: 1.94s    remaining: 1.06s
646:    learn: 1891.7023143     total: 1.95s    remaining: 1.06s
647:    learn: 1890.8626601     total: 1.95s    remaining: 1.06s
648:    learn: 1890.2112829     total: 1.95s    remaining: 1.05s
649:    learn: 1889.3433885     total: 1.95s    remaining: 1.05s
650:    learn: 1888.9126619     total: 1.96s    remaining: 1.05s
651:    learn: 1888.3837218     total: 1.96s    remaining: 1.04s
652:    learn: 1887.8885365     total: 1.96s    remaining: 1.04s
653:    learn: 1887.3483138     total: 1.96s    remaining: 1.04s
654:    learn: 1886.9111300     total: 1.96s    remaining: 1.03s
655:    learn: 1886.3220097     total: 1.97s    remaining: 1.03s
656:    learn: 1885.8931717     total: 1.97s    remaining: 1.03s
657:    learn: 1885.1087479     total: 1.97s    remaining: 1.02s
658:    learn: 1884.5011116     total: 1.97s    remaining: 1.02s
659:    learn: 1884.2579543     total: 1.97s    remaining: 1.02s
660:    learn: 1883.3008211     total: 1.98s    remaining: 1.01s
661:    learn: 1882.9331815     total: 1.98s    remaining: 1.01s
662:    learn: 1881.8953429     total: 1.98s    remaining: 1.01s
663:    learn: 1880.8118621     total: 1.98s    remaining: 1s
664:    learn: 1880.2919003     total: 1.99s    remaining: 1s
665:    learn: 1879.5990099     total: 1.99s    remaining: 997ms
666:    learn: 1878.4281242     total: 1.99s    remaining: 993ms
667:    learn: 1878.3243355     total: 1.99s    remaining: 990ms
668:    learn: 1877.9804301     total: 1.99s    remaining: 986ms
669:    learn: 1877.1503718     total: 2s       remaining: 983ms
670:    learn: 1876.2848311     total: 2s       remaining: 979ms
671:    learn: 1875.3697357     total: 2s       remaining: 976ms
672:    learn: 1874.8049145     total: 2s       remaining: 973ms
673:    learn: 1874.1463411     total: 2s       remaining: 969ms
674:    learn: 1873.9620905     total: 2s       remaining: 966ms
675:    learn: 1873.4402361     total: 2.01s    remaining: 962ms
676:    learn: 1873.1993765     total: 2.01s    remaining: 959ms
677:    learn: 1872.8204204     total: 2.01s    remaining: 955ms
678:    learn: 1872.5380479     total: 2.01s    remaining: 952ms
679:    learn: 1871.7768933     total: 2.02s    remaining: 948ms
680:    learn: 1871.3743724     total: 2.02s    remaining: 945ms
681:    learn: 1870.7881725     total: 2.02s    remaining: 942ms
682:    learn: 1870.4025613     total: 2.02s    remaining: 938ms
683:    learn: 1870.0418075     total: 2.02s    remaining: 935ms
684:    learn: 1869.2604482     total: 2.02s    remaining: 932ms
685:    learn: 1868.5241615     total: 2.03s    remaining: 928ms
686:    learn: 1867.8327114     total: 2.03s    remaining: 925ms
687:    learn: 1867.2799133     total: 2.03s    remaining: 922ms
688:    learn: 1866.4215538     total: 2.03s    remaining: 918ms
689:    learn: 1866.0338917     total: 2.04s    remaining: 915ms
690:    learn: 1865.8273446     total: 2.04s    remaining: 912ms
691:    learn: 1865.6173040     total: 2.04s    remaining: 908ms
692:    learn: 1864.8274188     total: 2.04s    remaining: 905ms
693:    learn: 1864.6383065     total: 2.04s    remaining: 902ms
694:    learn: 1864.3052500     total: 2.05s    remaining: 898ms
695:    learn: 1864.0189650     total: 2.05s    remaining: 895ms
696:    learn: 1863.5290171     total: 2.05s    remaining: 892ms
697:    learn: 1862.6778205     total: 2.05s    remaining: 889ms
698:    learn: 1862.1573619     total: 2.06s    remaining: 885ms
699:    learn: 1861.8648612     total: 2.06s    remaining: 882ms
700:    learn: 1861.6103430     total: 2.06s    remaining: 879ms
701:    learn: 1861.1424473     total: 2.06s    remaining: 875ms
702:    learn: 1860.8810968     total: 2.06s    remaining: 872ms
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703:    learn: 1859.8882185     total: 2.07s    remaining: 869ms
704:    learn: 1858.7267502     total: 2.07s    remaining: 865ms
705:    learn: 1858.1126693     total: 2.07s    remaining: 862ms
706:    learn: 1857.9878389     total: 2.07s    remaining: 859ms
707:    learn: 1857.4260751     total: 2.07s    remaining: 855ms
708:    learn: 1856.9981176     total: 2.08s    remaining: 852ms
709:    learn: 1856.5217235     total: 2.08s    remaining: 849ms
710:    learn: 1856.0404577     total: 2.08s    remaining: 845ms
711:    learn: 1855.6168080     total: 2.08s    remaining: 842ms
712:    learn: 1855.3040779     total: 2.08s    remaining: 839ms
713:    learn: 1854.9524441     total: 2.08s    remaining: 835ms
714:    learn: 1854.3581392     total: 2.09s    remaining: 832ms
715:    learn: 1853.8134038     total: 2.09s    remaining: 829ms
716:    learn: 1853.4124383     total: 2.09s    remaining: 825ms
717:    learn: 1853.1509273     total: 2.09s    remaining: 822ms
718:    learn: 1852.2060071     total: 2.1s     remaining: 819ms
719:    learn: 1851.8760316     total: 2.1s     remaining: 816ms
720:    learn: 1851.2267779     total: 2.1s     remaining: 812ms
721:    learn: 1850.6317540     total: 2.1s     remaining: 809ms
722:    learn: 1850.2717152     total: 2.1s     remaining: 806ms
723:    learn: 1849.8970084     total: 2.1s     remaining: 803ms
724:    learn: 1849.3087370     total: 2.11s    remaining: 799ms
725:    learn: 1848.8138692     total: 2.11s    remaining: 796ms
726:    learn: 1848.1656005     total: 2.11s    remaining: 793ms
727:    learn: 1847.8655668     total: 2.11s    remaining: 790ms
728:    learn: 1847.1394999     total: 2.12s    remaining: 787ms
729:    learn: 1846.8282986     total: 2.12s    remaining: 783ms
730:    learn: 1846.3732351     total: 2.12s    remaining: 780ms
731:    learn: 1846.0530971     total: 2.12s    remaining: 777ms
732:    learn: 1845.3742062     total: 2.12s    remaining: 774ms
733:    learn: 1844.7162843     total: 2.13s    remaining: 771ms
734:    learn: 1844.1969072     total: 2.13s    remaining: 768ms
735:    learn: 1843.8096021     total: 2.13s    remaining: 764ms
736:    learn: 1843.3882974     total: 2.13s    remaining: 761ms
737:    learn: 1842.7255381     total: 2.13s    remaining: 758ms
738:    learn: 1842.4242583     total: 2.14s    remaining: 755ms
739:    learn: 1841.5274214     total: 2.14s    remaining: 752ms
740:    learn: 1840.9912920     total: 2.14s    remaining: 748ms
741:    learn: 1840.5577051     total: 2.14s    remaining: 745ms
742:    learn: 1840.0842571     total: 2.15s    remaining: 742ms
743:    learn: 1839.5748939     total: 2.15s    remaining: 739ms
744:    learn: 1838.9756370     total: 2.15s    remaining: 736ms
745:    learn: 1838.7807856     total: 2.15s    remaining: 733ms
746:    learn: 1838.5108443     total: 2.15s    remaining: 729ms
747:    learn: 1838.2971882     total: 2.17s    remaining: 732ms
748:    learn: 1838.1554962     total: 2.17s    remaining: 729ms
749:    learn: 1837.6815931     total: 2.18s    remaining: 726ms
750:    learn: 1837.3949117     total: 2.18s    remaining: 723ms
751:    learn: 1836.9118931     total: 2.18s    remaining: 719ms
752:    learn: 1836.5942156     total: 2.18s    remaining: 716ms
753:    learn: 1836.0911278     total: 2.19s    remaining: 713ms
754:    learn: 1835.2430026     total: 2.19s    remaining: 710ms
755:    learn: 1834.6333354     total: 2.19s    remaining: 707ms
756:    learn: 1834.2180227     total: 2.19s    remaining: 704ms
757:    learn: 1833.7162881     total: 2.19s    remaining: 700ms
758:    learn: 1832.9990843     total: 2.2s     remaining: 697ms
759:    learn: 1832.4344414     total: 2.2s     remaining: 694ms
760:    learn: 1832.0759308     total: 2.2s     remaining: 691ms
761:    learn: 1831.2150988     total: 2.2s     remaining: 688ms
762:    learn: 1830.7341410     total: 2.2s     remaining: 685ms
763:    learn: 1830.0868884     total: 2.21s    remaining: 682ms
764:    learn: 1829.6416284     total: 2.21s    remaining: 678ms
765:    learn: 1829.3592558     total: 2.21s    remaining: 675ms
766:    learn: 1829.1892450     total: 2.21s    remaining: 672ms
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767:    learn: 1828.6484600     total: 2.21s    remaining: 669ms
768:    learn: 1828.2241791     total: 2.22s    remaining: 666ms
769:    learn: 1827.8810308     total: 2.22s    remaining: 663ms
770:    learn: 1827.4424821     total: 2.22s    remaining: 660ms
771:    learn: 1827.2454957     total: 2.22s    remaining: 657ms
772:    learn: 1826.9761780     total: 2.23s    remaining: 653ms
773:    learn: 1826.8508541     total: 2.23s    remaining: 650ms
774:    learn: 1826.1556948     total: 2.23s    remaining: 647ms
775:    learn: 1826.0890070     total: 2.23s    remaining: 644ms
776:    learn: 1825.6752772     total: 2.23s    remaining: 641ms
777:    learn: 1825.5052971     total: 2.23s    remaining: 638ms
778:    learn: 1824.7565321     total: 2.24s    remaining: 635ms
779:    learn: 1824.4605237     total: 2.24s    remaining: 632ms
780:    learn: 1824.3016917     total: 2.24s    remaining: 629ms
781:    learn: 1824.2254530     total: 2.24s    remaining: 625ms
782:    learn: 1823.5647602     total: 2.25s    remaining: 622ms
783:    learn: 1823.3917795     total: 2.25s    remaining: 619ms
784:    learn: 1822.9903767     total: 2.25s    remaining: 616ms
785:    learn: 1822.8064836     total: 2.25s    remaining: 613ms
786:    learn: 1822.1083932     total: 2.25s    remaining: 610ms
787:    learn: 1821.9120434     total: 2.25s    remaining: 607ms
788:    learn: 1821.6499075     total: 2.26s    remaining: 604ms
789:    learn: 1821.2670455     total: 2.26s    remaining: 601ms
790:    learn: 1821.1739018     total: 2.26s    remaining: 597ms
791:    learn: 1820.6256570     total: 2.26s    remaining: 594ms
792:    learn: 1820.2249535     total: 2.27s    remaining: 591ms
793:    learn: 1820.0365064     total: 2.27s    remaining: 588ms
794:    learn: 1819.9594344     total: 2.27s    remaining: 585ms
795:    learn: 1819.7373605     total: 2.27s    remaining: 582ms
796:    learn: 1819.6360064     total: 2.27s    remaining: 579ms
797:    learn: 1819.0250404     total: 2.27s    remaining: 576ms
798:    learn: 1818.5546169     total: 2.28s    remaining: 573ms
799:    learn: 1817.9697745     total: 2.28s    remaining: 570ms
800:    learn: 1817.6429082     total: 2.28s    remaining: 567ms
801:    learn: 1817.3875643     total: 2.28s    remaining: 564ms
802:    learn: 1817.0405487     total: 2.29s    remaining: 561ms
803:    learn: 1816.6298249     total: 2.29s    remaining: 558ms
804:    learn: 1816.4275671     total: 2.29s    remaining: 555ms
805:    learn: 1816.0488038     total: 2.29s    remaining: 552ms
806:    learn: 1815.5889320     total: 2.29s    remaining: 549ms
807:    learn: 1815.1635543     total: 2.3s     remaining: 546ms
808:    learn: 1814.9869989     total: 2.3s     remaining: 543ms
809:    learn: 1814.5625942     total: 2.3s     remaining: 540ms
810:    learn: 1814.4407613     total: 2.3s     remaining: 537ms
811:    learn: 1814.0073464     total: 2.3s     remaining: 533ms
812:    learn: 1813.3837940     total: 2.31s    remaining: 530ms
813:    learn: 1813.0387077     total: 2.31s    remaining: 527ms
814:    learn: 1812.3367401     total: 2.31s    remaining: 524ms
815:    learn: 1812.1783179     total: 2.31s    remaining: 521ms
816:    learn: 1811.6097266     total: 2.31s    remaining: 518ms
817:    learn: 1811.2447754     total: 2.32s    remaining: 515ms
818:    learn: 1810.9716805     total: 2.32s    remaining: 512ms
819:    learn: 1810.5056033     total: 2.32s    remaining: 509ms
820:    learn: 1810.3937699     total: 2.32s    remaining: 506ms
821:    learn: 1810.2554970     total: 2.32s    remaining: 503ms
822:    learn: 1810.1910770     total: 2.33s    remaining: 500ms
823:    learn: 1809.6263285     total: 2.33s    remaining: 497ms
824:    learn: 1809.0646418     total: 2.33s    remaining: 494ms
825:    learn: 1808.4898234     total: 2.33s    remaining: 491ms
826:    learn: 1807.9839126     total: 2.33s    remaining: 488ms
827:    learn: 1807.3756544     total: 2.34s    remaining: 485ms
828:    learn: 1807.2868554     total: 2.34s    remaining: 482ms
829:    learn: 1807.0652145     total: 2.34s    remaining: 479ms
830:    learn: 1806.5751926     total: 2.34s    remaining: 476ms
```

```
831:    learn: 1806.1179303     total: 2.34s    remaining: 473ms
832:    learn: 1805.3035075     total: 2.35s    remaining: 470ms
833:    learn: 1804.9878673     total: 2.35s    remaining: 467ms
834:    learn: 1804.3690997     total: 2.35s    remaining: 464ms
835:    learn: 1804.1688069     total: 2.35s    remaining: 461ms
836:    learn: 1803.9553067     total: 2.35s    remaining: 458ms
837:    learn: 1803.6464947     total: 2.35s    remaining: 455ms
838:    learn: 1803.0318409     total: 2.36s    remaining: 452ms
839:    learn: 1802.8187230     total: 2.36s    remaining: 449ms
840:    learn: 1802.3945271     total: 2.36s    remaining: 446ms
841:    learn: 1802.0137830     total: 2.36s    remaining: 443ms
842:    learn: 1801.3581633     total: 2.36s    remaining: 440ms
843:    learn: 1801.1757536     total: 2.37s    remaining: 437ms
844:    learn: 1800.3400134     total: 2.37s    remaining: 434ms
845:    learn: 1800.0221553     total: 2.37s    remaining: 431ms
846:    learn: 1799.7478015     total: 2.37s    remaining: 428ms
847:    learn: 1799.2891830     total: 2.37s    remaining: 426ms
848:    learn: 1798.7415508     total: 2.38s    remaining: 423ms
849:    learn: 1798.5309317     total: 2.38s    remaining: 420ms
850:    learn: 1797.9269325     total: 2.38s    remaining: 417ms
851:    learn: 1797.4288012     total: 2.38s    remaining: 414ms
852:    learn: 1797.1702549     total: 2.38s    remaining: 411ms
853:    learn: 1796.8089865     total: 2.39s    remaining: 408ms
854:    learn: 1796.2674972     total: 2.39s    remaining: 405ms
855:    learn: 1795.8492576     total: 2.39s    remaining: 402ms
856:    learn: 1795.1864573     total: 2.39s    remaining: 399ms
857:    learn: 1795.0338384     total: 2.39s    remaining: 396ms
858:    learn: 1794.4193927     total: 2.4s     remaining: 393ms
859:    learn: 1793.9793111     total: 2.4s     remaining: 390ms
860:    learn: 1793.4936663     total: 2.4s     remaining: 388ms
861:    learn: 1793.2376389     total: 2.4s     remaining: 385ms
862:    learn: 1793.1369675     total: 2.4s     remaining: 382ms
863:    learn: 1792.7122717     total: 2.41s    remaining: 379ms
864:    learn: 1792.6338141     total: 2.41s    remaining: 376ms
865:    learn: 1792.5074350     total: 2.41s    remaining: 373ms
866:    learn: 1791.9989241     total: 2.41s    remaining: 370ms
867:    learn: 1791.7387477     total: 2.42s    remaining: 367ms
868:    learn: 1791.3059747     total: 2.42s    remaining: 365ms
869:    learn: 1791.0804493     total: 2.42s    remaining: 362ms
870:    learn: 1790.5609758     total: 2.42s    remaining: 359ms
871:    learn: 1789.2354563     total: 2.43s    remaining: 356ms
872:    learn: 1788.7789194     total: 2.43s    remaining: 353ms
873:    learn: 1788.3708938     total: 2.43s    remaining: 351ms
874:    learn: 1788.0912916     total: 2.43s    remaining: 348ms
875:    learn: 1787.7280569     total: 2.44s    remaining: 345ms
876:    learn: 1787.4605617     total: 2.44s    remaining: 342ms
877:    learn: 1786.9449359     total: 2.44s    remaining: 339ms
878:    learn: 1786.1246699     total: 2.44s    remaining: 337ms
879:    learn: 1785.7837167     total: 2.45s    remaining: 334ms
880:    learn: 1785.3910570     total: 2.45s    remaining: 331ms
881:    learn: 1784.9856273     total: 2.45s    remaining: 328ms
882:    learn: 1784.6599063     total: 2.46s    remaining: 326ms
883:    learn: 1784.2099033     total: 2.46s    remaining: 323ms
884:    learn: 1783.7758215     total: 2.46s    remaining: 320ms
885:    learn: 1783.2905510     total: 2.46s    remaining: 317ms
886:    learn: 1782.9781982     total: 2.47s    remaining: 315ms
887:    learn: 1782.5878222     total: 2.47s    remaining: 312ms
888:    learn: 1782.1221135     total: 2.48s    remaining: 309ms
889:    learn: 1781.7469244     total: 2.48s    remaining: 306ms
890:    learn: 1781.4645291     total: 2.48s    remaining: 304ms
891:    learn: 1780.9893011     total: 2.48s    remaining: 301ms
892:    learn: 1780.7714096     total: 2.49s    remaining: 298ms
893:    learn: 1780.3638360     total: 2.49s    remaining: 295ms
894:    learn: 1780.0108152     total: 2.5s     remaining: 293ms
```

```
895:    learn: 1779.6635016     total: 2.5s     remaining: 290ms
896:    learn: 1779.1870503     total: 2.5s     remaining: 288ms
897:    learn: 1778.7528295     total: 2.51s    remaining: 285ms
898:    learn: 1778.5920931     total: 2.51s    remaining: 282ms
899:    learn: 1778.2239583     total: 2.52s    remaining: 280ms
900:    learn: 1777.7471154     total: 2.52s    remaining: 277ms
901:    learn: 1777.5176542     total: 2.52s    remaining: 274ms
902:    learn: 1777.3770790     total: 2.53s    remaining: 272ms
903:    learn: 1777.0561951     total: 2.53s    remaining: 269ms
904:    learn: 1776.5374147     total: 2.54s    remaining: 266ms
905:    learn: 1776.3245179     total: 2.54s    remaining: 264ms
906:    learn: 1775.8393380     total: 2.55s    remaining: 261ms
907:    learn: 1775.8045172     total: 2.55s    remaining: 258ms
908:    learn: 1775.2435212     total: 2.55s    remaining: 256ms
909:    learn: 1774.8436022     total: 2.56s    remaining: 253ms
910:    learn: 1774.6212001     total: 2.56s    remaining: 250ms
911:    learn: 1774.3367122     total: 2.56s    remaining: 247ms
912:    learn: 1774.0017165     total: 2.56s    remaining: 244ms
913:    learn: 1773.5143396     total: 2.57s    remaining: 242ms
914:    learn: 1773.1117119     total: 2.57s    remaining: 239ms
915:    learn: 1772.6524040     total: 2.58s    remaining: 236ms
916:    learn: 1772.2484336     total: 2.58s    remaining: 233ms
917:    learn: 1771.4331827     total: 2.58s    remaining: 231ms
918:    learn: 1771.0867447     total: 2.59s    remaining: 229ms
919:    learn: 1770.8392602     total: 2.6s     remaining: 226ms
920:    learn: 1770.7164640     total: 2.6s     remaining: 223ms
921:    learn: 1770.5303877     total: 2.6s     remaining: 220ms
922:    learn: 1770.2509943     total: 2.61s    remaining: 218ms
923:    learn: 1770.0261880     total: 2.61s    remaining: 215ms
924:    learn: 1769.8512644     total: 2.62s    remaining: 212ms
925:    learn: 1769.6826137     total: 2.62s    remaining: 210ms
926:    learn: 1769.5443604     total: 2.63s    remaining: 207ms
927:    learn: 1769.0450799     total: 2.63s    remaining: 204ms
928:    learn: 1768.8396681     total: 2.63s    remaining: 201ms
929:    learn: 1768.4330357     total: 2.64s    remaining: 199ms
930:    learn: 1768.2029196     total: 2.64s    remaining: 196ms
931:    learn: 1768.0103087     total: 2.65s    remaining: 193ms
932:    learn: 1767.5246651     total: 2.65s    remaining: 190ms
933:    learn: 1767.1559969     total: 2.65s    remaining: 188ms
934:    learn: 1766.9171115     total: 2.66s    remaining: 185ms
935:    learn: 1766.8486393     total: 2.66s    remaining: 182ms
936:    learn: 1766.1131202     total: 2.67s    remaining: 179ms
937:    learn: 1766.0621566     total: 2.67s    remaining: 177ms
938:    learn: 1765.5383419     total: 2.68s    remaining: 174ms
939:    learn: 1765.3704985     total: 2.68s    remaining: 171ms
940:    learn: 1765.0197163     total: 2.68s    remaining: 168ms
941:    learn: 1764.9703037     total: 2.69s    remaining: 166ms
942:    learn: 1764.6356857     total: 2.69s    remaining: 163ms
943:    learn: 1763.4930651     total: 2.7s     remaining: 160ms
944:    learn: 1763.2867594     total: 2.7s     remaining: 157ms
945:    learn: 1763.0809250     total: 2.7s     remaining: 154ms
946:    learn: 1762.6697747     total: 2.71s    remaining: 152ms
947:    learn: 1762.4143195     total: 2.71s    remaining: 149ms
948:    learn: 1761.8192732     total: 2.71s    remaining: 146ms
949:    learn: 1761.5198440     total: 2.72s    remaining: 143ms
950:    learn: 1761.1521692     total: 2.72s    remaining: 140ms
951:    learn: 1761.1095808     total: 2.72s    remaining: 137ms
952:    learn: 1761.0675867     total: 2.73s    remaining: 135ms
953:    learn: 1760.7640576     total: 2.73s    remaining: 132ms
954:    learn: 1760.3792800     total: 2.74s    remaining: 129ms
955:    learn: 1759.6518712     total: 2.74s    remaining: 126ms
956:    learn: 1759.4497025     total: 2.74s    remaining: 123ms
957:    learn: 1759.0262086     total: 2.75s    remaining: 120ms
958:    learn: 1758.7960929     total: 2.75s    remaining: 118ms
```

```
959:    learn: 1758.4086073     total: 2.75s    remaining: 115ms
960:    learn: 1757.8112351     total: 2.75s    remaining: 112ms
961:    learn: 1757.3952373     total: 2.76s    remaining: 109ms
962:    learn: 1757.1047115     total: 2.76s    remaining: 106ms
963:    learn: 1756.7926026     total: 2.76s    remaining: 103ms
964:    learn: 1756.5913497     total: 2.77s    remaining: 100ms
965:    learn: 1755.9837166     total: 2.77s    remaining: 97.6ms
966:    learn: 1755.6768098     total: 2.78s    remaining: 94.7ms
967:    learn: 1754.8607866     total: 2.78s    remaining: 91.9ms
968:    learn: 1754.4363327     total: 2.78s    remaining: 89ms
969:    learn: 1754.1012767     total: 2.79s    remaining: 86.2ms
970:    learn: 1754.0590383     total: 2.79s    remaining: 83.4ms
971:    learn: 1754.0276482     total: 2.8s     remaining: 80.6ms
972:    learn: 1753.6900163     total: 2.8s     remaining: 77.7ms
973:    learn: 1753.4898303     total: 2.8s     remaining: 74.9ms
974:    learn: 1753.1382510     total: 2.81s    remaining: 72ms
975:    learn: 1752.9759956     total: 2.81s    remaining: 69.2ms
976:    learn: 1752.4886527     total: 2.82s    remaining: 66.3ms
977:    learn: 1752.1839126     total: 2.82s    remaining: 63.5ms
978:    learn: 1752.0525156     total: 2.83s    remaining: 60.6ms
979:    learn: 1751.7405925     total: 2.83s    remaining: 57.7ms
980:    learn: 1751.1751364     total: 2.83s    remaining: 54.8ms
981:    learn: 1750.7142996     total: 2.83s    remaining: 52ms
982:    learn: 1750.5374169     total: 2.84s    remaining: 49.1ms
983:    learn: 1750.1676990     total: 2.84s    remaining: 46.2ms
984:    learn: 1749.7515123     total: 2.85s    remaining: 43.3ms
985:    learn: 1749.6574192     total: 2.85s    remaining: 40.5ms
986:    learn: 1749.1896319     total: 2.85s    remaining: 37.6ms
987:    learn: 1749.0112297     total: 2.86s    remaining: 34.7ms
988:    learn: 1748.5514670     total: 2.86s    remaining: 31.8ms
989:    learn: 1748.2974932     total: 2.87s    remaining: 29ms
990:    learn: 1748.0133893     total: 2.87s    remaining: 26.1ms
991:    learn: 1747.5984765     total: 2.87s    remaining: 23.2ms
992:    learn: 1747.4685999     total: 2.88s    remaining: 20.3ms
993:    learn: 1746.9857191     total: 2.88s    remaining: 17.4ms
994:    learn: 1746.4867807     total: 2.88s    remaining: 14.5ms
995:    learn: 1745.9139596     total: 2.88s    remaining: 11.6ms
996:    learn: 1745.8386895     total: 2.89s    remaining: 8.69ms
997:    learn: 1745.4094098     total: 2.89s    remaining: 5.79ms
998:    learn: 1745.2206599     total: 2.89s    remaining: 2.89ms
999:    learn: 1745.0233011     total: 2.89s    remaining: 0us
<catboost.core.CatBoostRegressor object at 0x000001B09DF8F8E0>
```

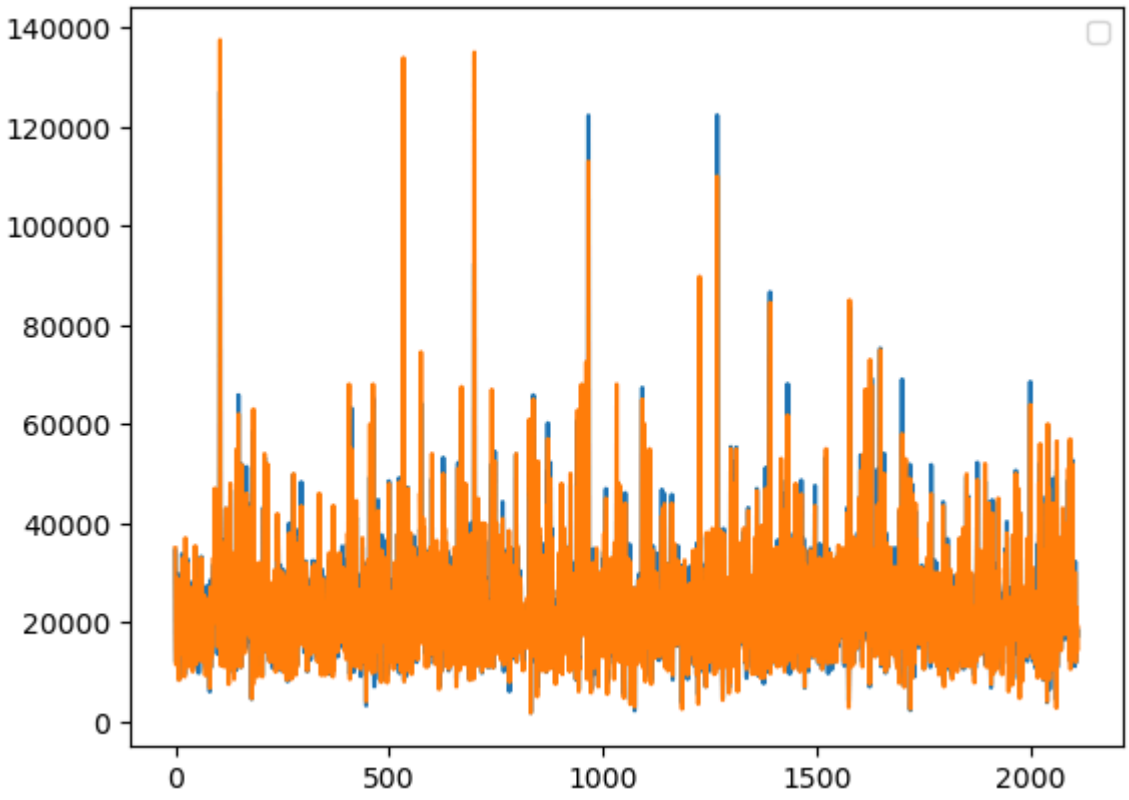
In [60]:
```
cat_pred=cat.predict(X_test)
display (cat_pred)
```

```
array([34403.2885362 , 18068.56325027, 11918.19730173, ...,
       18621.48599089, 16917.10863635, 18220.58207119])
```

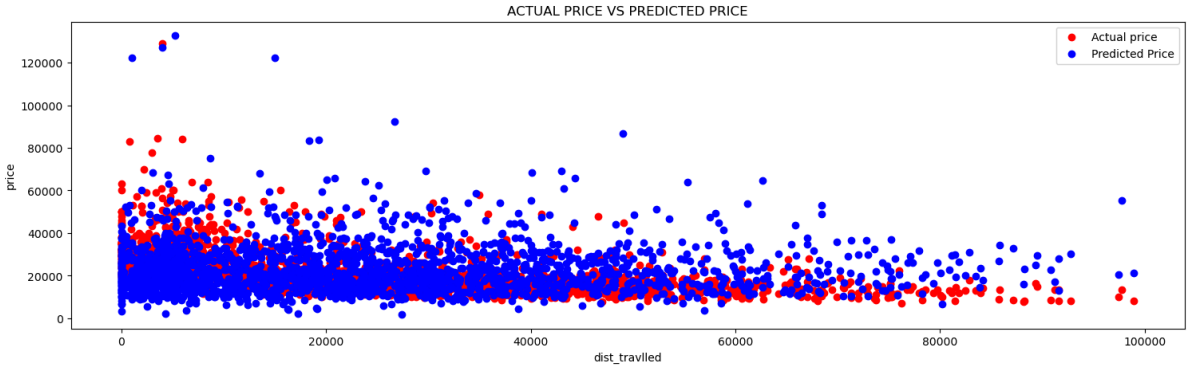
In [61]:
```
display (r2_score(Y_test,cat_pred))
print('MAE',mean_absolute_error(Y_test,cat_pred))
print('MSE', mean_squared_error(Y_test,cat_pred))
```

```
0.9621533622246573
MAE 1440.7720299246405
MSE 5508195.786795388
```

In [62]:
```
plt.plot(cat_pred,label='pred')
plt.plot(Y_test,label='Actual')
plt.legend('a','b')
plt.show()
```



In [63]:
```
%matplotlib inline
plt.figure(figsize=(18,5))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,actual,color='red')
plt.scatter(distance,cat_pred,color='blue')
plt.title('ACTUAL PRICE VS PREDICTED PRICE')
plt.legend(['Actual price ','Predicted Price'])
plt.show()
```



In [ ]:

using knn regressor

In [64]:
```
'''from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsRegressor
from sklearn.metrics import mean_squared_error'''
```

Out[64]:
```
'from sklearn.model_selection import train_test_split\nfrom sklearn.neighbors impo
rt KNeighborsRegressor\nfrom sklearn.metrics import mean_squared_error'
```

In [65]:
```
#X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.2, random_st
```

In [66]:
```
#knn_regressor = KNeighborsRegressor(n_neighbors=4)
```

In [67]:
```
#knn_regressor.fit(X_train, y_train)
```

In [68]:
```
#y_pred = knn_regressor.predict(X_test)
#print(y_pred)
```

In [69]:
```
#mse = mean_squared_error(y_test, y_pred)
#print(f'Mean Squared Error: {mse}')
```

In [70]:
```
#from sklearn.metrics import r2_score,mean_absolute_error
#print  ('R2 Score ', r2_score(Y_test, y_pred))
#print  ('Mean Absolute Error', mean_absolute_error(Y_test,y_pred))
```

In [71]:
```
'''%matplotlib inline
plt.figure(figsize=(10, 6))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,actual,color='red')
plt.scatter(distance,y_pred,color='blue')

plt.legend(['Actual price ','Predicted Price'])
plt.show()'''

## knn regressor is not good
```

Out[71]:
```
"%matplotlib inline\nplt.figure(figsize=(10, 6))\nplt.xlabel('dist_travlled')\npl
t.ylabel('price')\nplt.scatter(distance,actual,color='red')\nplt.scatter(distance,
y_pred,color='blue')\n\nplt.legend(['Actual price ','Predicted Price'])\nplt.show
()"
```

decision tree regressor

In [72]:
```
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import mean_squared_error, r2_score
```

In [ ]:
```
```

In [73]:
```
decision_tree_regressor = DecisionTreeRegressor(random_state=42)
```

In [74]:
```
decision_tree_regressor.fit(X_train, Y_train)
```

Out[74]:
```
DecisionTreeRegressor(random_state=42)
```

In [75]:
```
y_pred = decision_tree_regressor.predict(X_test)
```

In [76]:
```
mse = mean_squared_error(Y_test, y_pred)
r2 = r2_score(Y_test, y_pred)
print('MAE',mean_absolute_error(Y_test,y_pred))
```

```
MAE 1921.797128884682
```

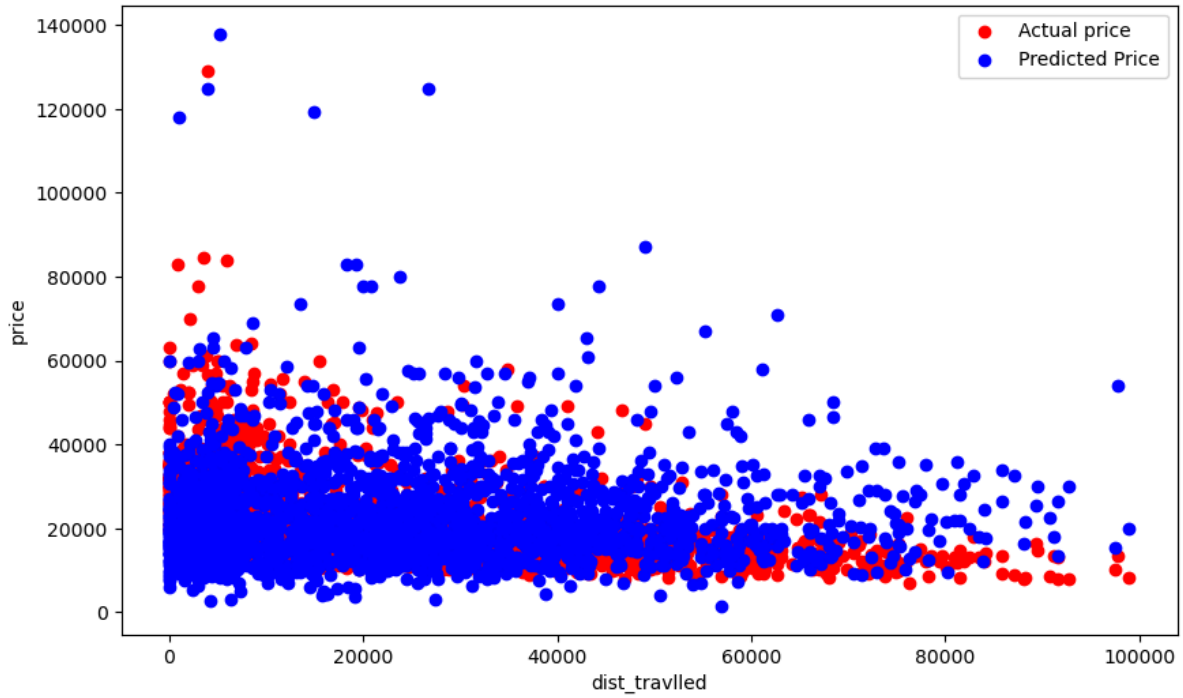
finding accuracy

In [77]:
```
print(r2)
```

```
0.9337260347094475
```

In [78]:
```
%matplotlib inline
plt.figure(figsize=(10, 6))
plt.xlabel('dist_travlled')
plt.ylabel('price')
plt.scatter(distance,actual,color='red')
plt.scatter(distance,y_pred,color='blue')

plt.legend(['Actual price ','Predicted Price'])
plt.show()
```



Conclusion

Random forest and decision tree are giving high accuracy than linear and knn regressor and desicion tree regressor is also showing better result, and also done randomized search CV for randomforest model by taking parameters randomly also gave good results

In [ ]:

In [ ]: