chap1-hw-mlops-zoomcamp-2023

May 19, 2023

1 MLOps-zoomcamp-2023-chap1-intro-hw

Use the "Run" button to execute the code.

1.1 Download the Dataset

[1]:
```
dataset_link_1 = "https://d37ci6vzurychx.cloudfront.net/trip-data/
  ↪yellow_tripdata_2022-01.parquet"
dataset_link_2 = "https://d37ci6vzurychx.cloudfront.net/trip-data/
  ↪yellow_tripdata_2022-02.parquet"
```

[2]:
```
!pwd
!wget $dataset_link_1
!wget $dataset_link_2
```

```
/content
--2023-05-19 14:07:36--  https://d37ci6vzurychx.cloudfront.net/trip-
data/yellow_tripdata_2022-01.parquet
Resolving d37ci6vzurychx.cloudfront.net (d37ci6vzurychx.cloudfront.net)…
65.8.245.178, 65.8.245.171, 65.8.245.50, …
Connecting to d37ci6vzurychx.cloudfront.net
(d37ci6vzurychx.cloudfront.net)|65.8.245.178|:443… connected.
HTTP request sent, awaiting response… 200 OK
Length: 38139949 (36M) [application/x-www-form-urlencoded]
Saving to: 'yellow_tripdata_2022-01.parquet'

yellow_tripdata_202 100%[===================>]  36.37M  59.2MB/s    in 0.6s

2023-05-19 14:07:37 (59.2 MB/s) - 'yellow_tripdata_2022-01.parquet' saved
[38139949/38139949]

--2023-05-19 14:07:37--  https://d37ci6vzurychx.cloudfront.net/trip-
data/yellow_tripdata_2022-02.parquet
Resolving d37ci6vzurychx.cloudfront.net (d37ci6vzurychx.cloudfront.net)…
65.8.245.178, 65.8.245.171, 65.8.245.50, …
Connecting to d37ci6vzurychx.cloudfront.net
(d37ci6vzurychx.cloudfront.net)|65.8.245.178|:443… connected.
HTTP request sent, awaiting response… 200 OK
```

```
Length: 45616512 (44M) [application/x-www-form-urlencoded]
Saving to: 'yellow_tripdata_2022-02.parquet'

yellow_tripdata_202 100%[===================>]  43.50M  69.9MB/s    in 0.6s

2023-05-19 14:07:37 (69.9 MB/s) - 'yellow_tripdata_2022-02.parquet' saved
[45616512/45616512]
```

[94]:
```python
import pandas as pd

import seaborn as sns
import matplotlib.pyplot as plt


from sklearn.feature_extraction import DictVectorizer
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Lasso
from sklearn.linear_model import Ridge
```

[95]:
```python
# Specify the file path of the parquet file
parquet_file_train = 'yellow_tripdata_2022-01.parquet'
parquet_file_val = 'yellow_tripdata_2022-02.parquet'


# Read the parquet file using pandas
df_train = pd.read_parquet(parquet_file_train)
```

1.2 Data Analysis and Exploration

[96]:
```python
df_train.shape
```

[96]:
```
(2463931, 19)
```

1.2.1 Read the data for January. How many columns are there? 19

1.2.2 What's the standard deviation of the trips duration in January?

[97]:
```python
df_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2463931 entries, 0 to 2463930
Data columns (total 19 columns):
 #   Column                 Dtype
---  ------                 -----
 0   VendorID               int64
 1   tpep_pickup_datetime   datetime64[ns]
```

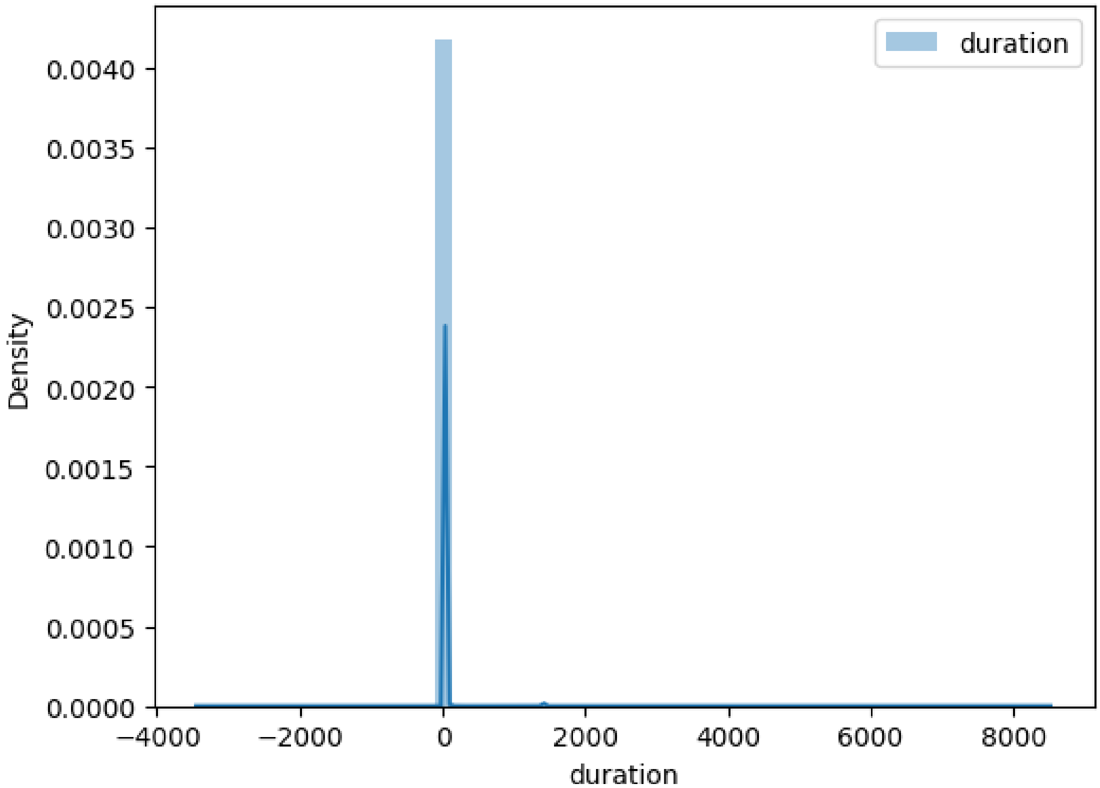
```
 2   tpep_dropoff_datetime  datetime64[ns]
 3   passenger_count        float64
 4   trip_distance          float64
 5   RatecodeID             float64
 6   store_and_fwd_flag     object
 7   PULocationID           int64
 8   DOLocationID           int64
 9   payment_type           int64
 10  fare_amount            float64
 11  extra                  float64
 12  mta_tax                float64
 13  tip_amount             float64
 14  tolls_amount           float64
 15  improvement_surcharge  float64
 16  total_amount           float64
 17  congestion_surcharge   float64
 18  airport_fee            float64
dtypes: datetime64[ns](2), float64(12), int64(4), object(1)
memory usage: 357.2+ MB
```

[98]:
```python
df_train['duration'] = df_train.tpep_dropoff_datetime - df_train.
 ↪tpep_pickup_datetime
df_train.duration = df_train.duration.apply(lambda td: td.total_seconds() / 60)
```

[99]:
```python
sns.distplot(df_train['duration'], label='duration')
plt.legend()
```

```
<ipython-input-99-16a96132d705>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df_train['duration'], label='duration')
```

[99]:
```
<matplotlib.legend.Legend at 0x7f68d041b9d0>
```



[100]:
```python
# Calculate the standard deviation of the column
std_dev = df_train['duration'].std()

# Print the result
print('Standard Deviation:', std_dev)
```

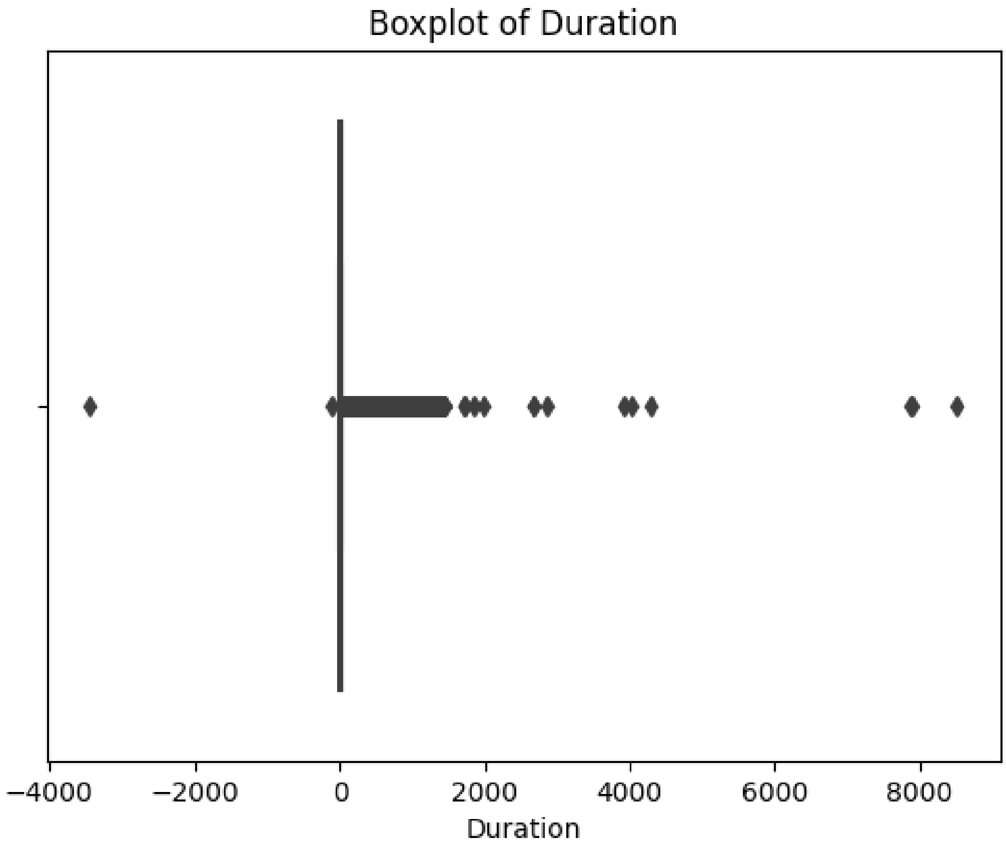
```
Standard Deviation: 46.44530513776802
```

What's the standard deviation of the trips duration in January? `46.445` ~ `46.45`

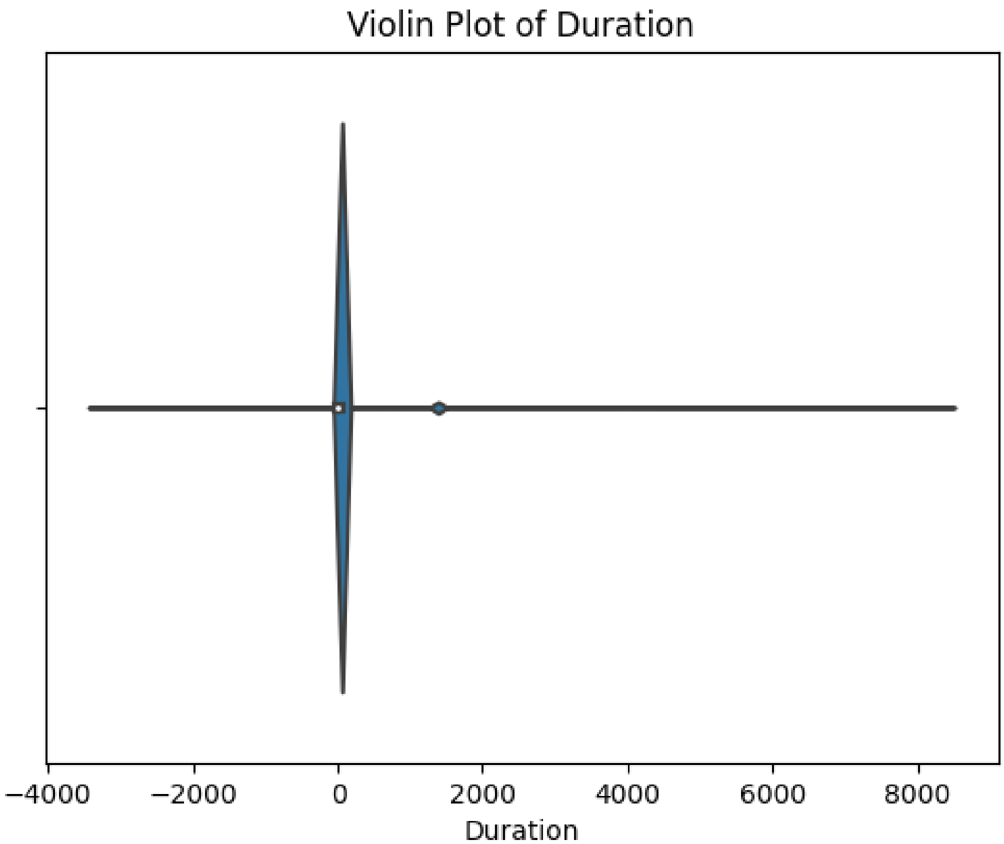
1.2.3 What fraction of the records left after you dropped the outliers?

[101]:
```python
# Boxplot
sns.boxplot(x=df_train['duration'])
plt.title('Boxplot of Duration')
plt.xlabel('Duration')
plt.show()

# Violin plot
sns.violinplot(x=df_train['duration'])
plt.title('Violin Plot of Duration')
plt.xlabel('Duration')
```

```
plt.show()
```



Boxplot of Duration
−4000
−2000
0
2000
4000
6000
8000
Duration

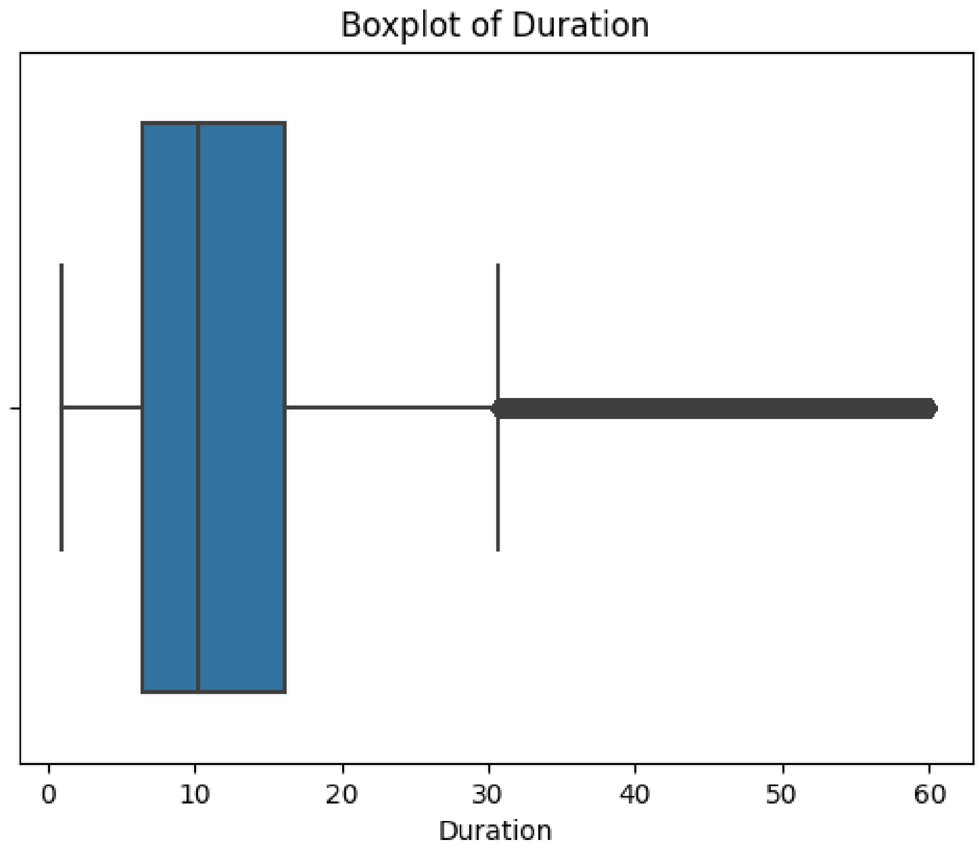


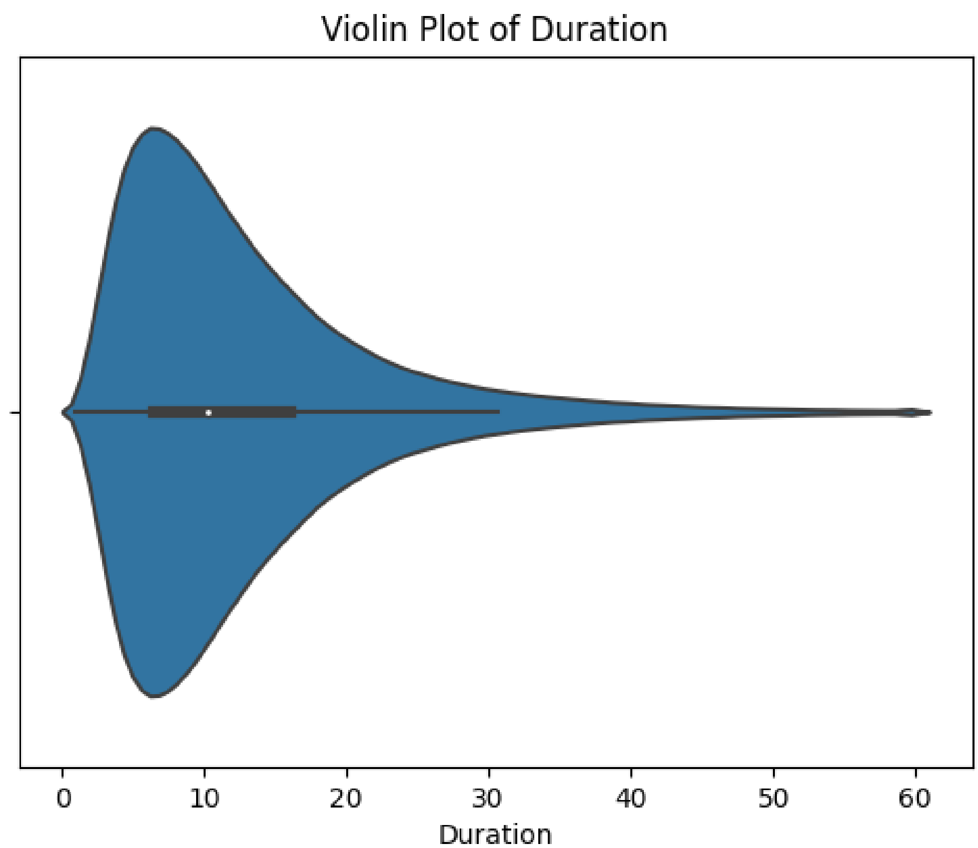
[102]:
```
df_train = df_train[(df_train.duration >= 1) & (df_train.duration <= 60)]
```

[103]:
```
df_train.shape
```

[103]: (2421440, 20)

[104]:
```
# Boxplot
sns.boxplot(x=df_train['duration'])
plt.title('Boxplot of Duration')
plt.xlabel('Duration')
plt.show()

# Violin plot
sns.violinplot(x=df_train['duration'])
plt.title('Violin Plot of Duration')
plt.xlabel('Duration')
plt.show()
```


Boxplot of Duration
0
10
20
30
40
50
60
Duration



Still the values could be trimmed by shriking the upper limit from 60 to 30. But as the questions states to trim between 1 and 60 so we have to stick to the same.

[105]:
```
print(f"The fraction of records left after dropping the otuliers is␣
↪{round(df_train.shape[0]*100/2463931,2)} %")
```

```
The fraction of records left after dropping the otuliers is 98.28 %
```

1.2.4 One-hot encoding

[106]:
```
df_train.columns
```

[106]:
```
Index(['VendorID', 'tpep_pickup_datetime', 'tpep_dropoff_datetime',
       'passenger_count', 'trip_distance', 'RatecodeID', 'store_and_fwd_flag',
       'PULocationID', 'DOLocationID', 'payment_type', 'fare_amount', 'extra',
       'mta_tax', 'tip_amount', 'tolls_amount', 'improvement_surcharge',
       'total_amount', 'congestion_surcharge', 'airport_fee', 'duration'],
      dtype='object')
```

[107]:
```
# selected_columns = ['PULocationID','DOLocationID']
```

[108]:
```
categorical = ['PULocationID', 'DOLocationID']
numerical = []
```

[109]:
```
def read_dataframe(filename):
    if filename.endswith('.parquet'):
        df = pd.read_parquet(filename)

    df['duration'] = df.tpep_dropoff_datetime - df.tpep_pickup_datetime
    df.duration = df.duration.apply(lambda td: td.total_seconds() / 60)

    df = df[(df.duration >= 1) & (df.duration <= 60)]

    categorical = ['PULocationID', 'DOLocationID']
    df[categorical] = df[categorical].astype(str)

    return df
```

[110]:
```
df_val = read_dataframe(parquet_file_val)
df_val.shape
```

[110]:
```
(2918187, 20)
```

[111]:
```
len(df_train), len(df_val)
```

[111]:
```
(2421440, 2918187)
```

[112]:
```
train_dicts = df_train[categorical + numerical].to_dict(orient='records')
```

[113]:
```
dv = DictVectorizer()
X_train = dv.fit_transform(train_dicts)
```

[114]:
```
X_train.shape,type(X_train)
```

[114]:
```
((2421440, 2), scipy.sparse._csr.csr_matrix)
```

[115]:
```
print(X_train[0])
```

```
  (0, 0)	236.0
  (0, 1)	142.0
```

[116]:
```
feature_names = dv.get_feature_names_out()
dimensionality = len(feature_names)
print(f'the dimensionality of this matrix (number of columns): 
 ↪{dimensionality}')
```

```
the dimensionality of this matrix (number of columns): 2
```

1.3 Training a model

[117]:
```
target = 'duration'
y_train = df_train[target].values
```

[118]:
```
lr = LinearRegression()
lr.fit(X_train, y_train)
```

[118]:
```
LinearRegression()
```

[119]:
```
from sklearn.metrics import mean_squared_error
```

[120]:
```
y_pred = lr.predict(X_train)
```

[121]:
```
print(f'the RMSE of the model on the training data {mean_squared_error(y_train,␣
↪y_pred, squared=False)}')
```

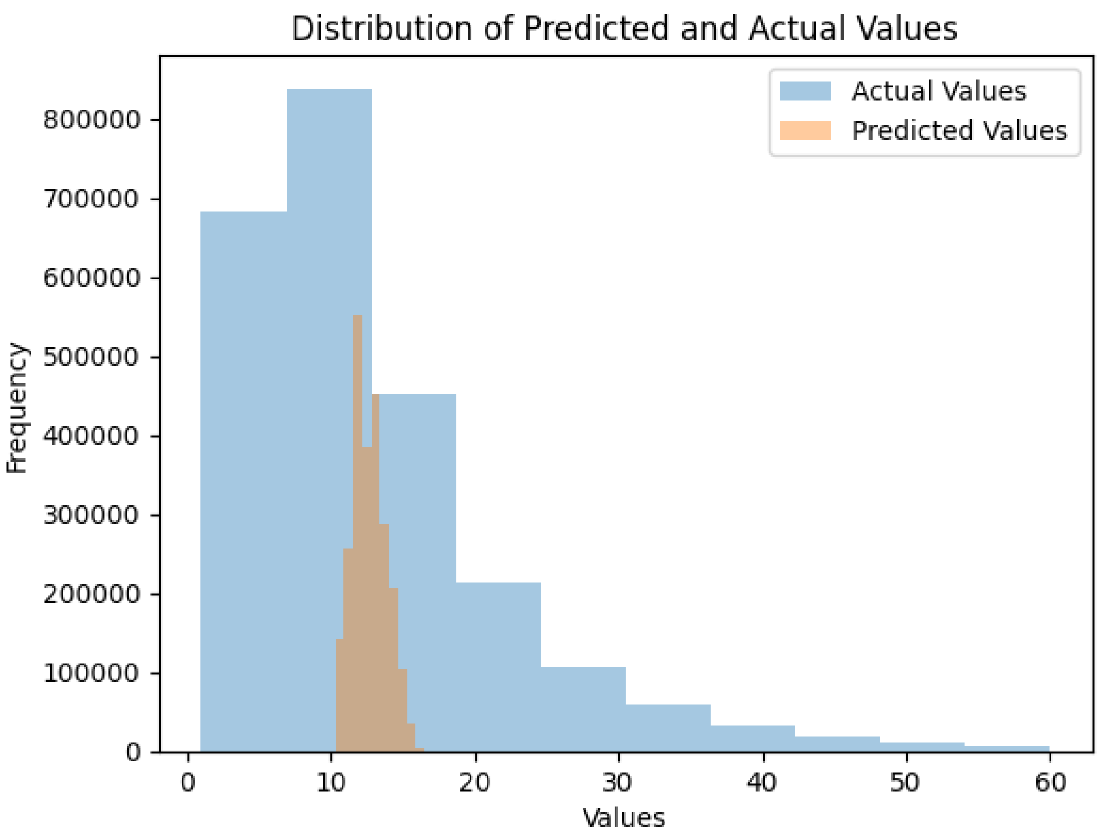
```
the RMSE of the model on the training data 8.920327827581444
```

[122]:
```
# Plotting the distributions
def plot_distribution(actual, predicted):
  sns.distplot(actual, hist=True, kde=False, bins=10, label='Actual Values')
  sns.distplot(predicted, hist=True, kde=False, bins=10, label='Predicted␣
↪Values')
  plt.xlabel('Values')
  plt.ylabel('Frequency')
  plt.legend()
  plt.title('Distribution of Predicted and Actual Values')
  plt.show()
```

[123]:
```
plot_distribution(y_train,y_pred)
```

```
<ipython-input-122-fc33e34a5dbe>:3: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(actual, hist=True, kde=False, bins=10, label='Actual Values')
<ipython-input-122-fc33e34a5dbe>:4: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
```

```
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(predicted, hist=True, kde=False, bins=10, label='Predicted
Values')
```



1.4 Evaluating the model

[124]:
```
val_dicts = df_val[categorical + numerical].to_dict(orient='records')
X_val = dv.transform(val_dicts)
```

[125]:
```
y_val = df_val[target].values
```

[126]:
```
y_pred = lr.predict(X_val)
```

[128]:
```
print(f'the RMSE of the model on the training data {mean_squared_error(y_val,␣
↪y_pred, squared=False)}')
```

```
the RMSE of the model on the training data 10.032124095033593
```

[129]:
```
plot_distribution(y_val,y_pred)
```

```
<ipython-input-122-fc33e34a5dbe>:3: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(actual, hist=True, kde=False, bins=10, label='Actual Values')
<ipython-input-122-fc33e34a5dbe>:4: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

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similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(predicted, hist=True, kde=False, bins=10, label='Predicted
Values')
```

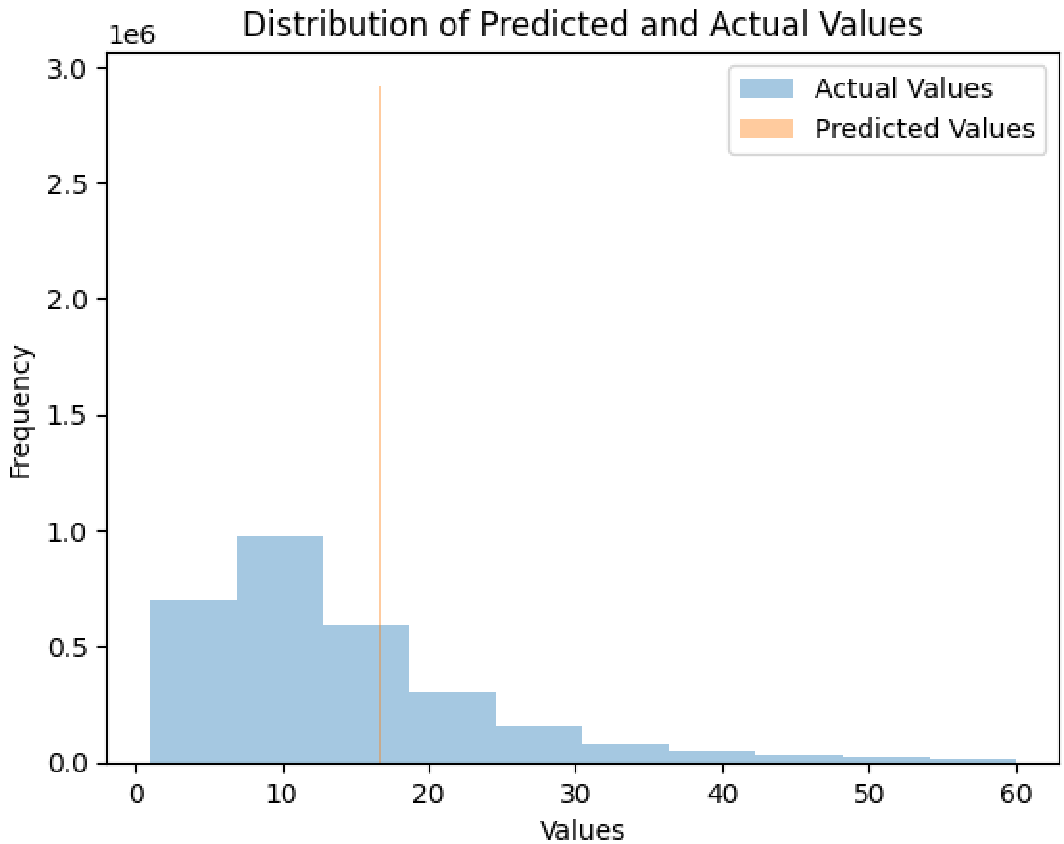

[130]:
```
y_pred
```

[130]:
```
array([16.56034382, 16.56034382, 16.56034382, …, 16.56034382,
       16.56034382, 16.56034382])
```

[ ]:

[ ]:

[ ]:

[ ]:

[ ]:

[ ]:
```
# df_train['PU_DO'] = df_train['PULocationID'] + '_' + df_train['DOLocationID']
# df_val['PU_DO'] = df_val['PULocationID'] + '_' + df_val['DOLocationID']
```

1.5 Similar things for the validation Dataset

[ ]:
```
# df_val['duration'] = df_val.tpep_dropoff_datetime - df_val.
↪tpep_pickup_datetime
# df_val.duration = df_val.duration.apply(lambda td: td.total_seconds() / 60)

# # Boxplot
# sns.boxplot(x=df_val['duration'])
# plt.title('Boxplot of Duration')
# plt.xlabel('Duration')
# plt.show()

# # Violin plot
# sns.violinplot(x=df_val['duration'])
# plt.title('Violin Plot of Duration')
# plt.xlabel('Duration')
# plt.show()
```

[90]:
```
from sklearn.feature_extraction import DictVectorizer

# Create an instance of DictVectorizer
vectorizer = DictVectorizer()

# Fit the vectorizer to your data
data = [{'feature1': 2, 'feature2': 5}, {'feature1': 1, 'feature3': 3}]
vectorizer.fit(data)

# Get the feature names
feature_names = vectorizer.get_feature_names_out()

# Determine the dimensionality
dimensionality = len(feature_names)

# Print the dimensionality
print("Dimensionality:", dimensionality)
```

```
Dimensionality: 3
```

[91]:
```
feature_names
```

[91]:
```
array(['feature1', 'feature2', 'feature3'], dtype=object)
```

[ ]:
```
```