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NapQueen's Assignment

Importing the data

```
import pandas as pd
train_data = pd.read_csv('/content/train.csv')
test_data = pd.read_csv('/content/test.csv')
train_data.head()
train_data.info()
train_data.describe()
train_data.isnull().sum()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 101490 entries, 0 to 101489
Data columns (total 8 columns):
 #   Column      Non-Null Count   Dtype  
---  ------      --------------   -----  
 0   ID          101490 non-null  object 
 1   date        101490 non-null  object 
 2   Item Id     101488 non-null  object 
 3   Item Name   99658 non-null   object 
 4   ad_spend    77303 non-null   float64
 5   anarix_id   101490 non-null  object 
 6   units       83592 non-null   float64
 7   unit_price  101490 non-null  float64
dtypes: float64(3), object(5)
memory usage: 6.2+ MB
```

	0
ID	0
date	0
Item Id	2
Item Name	1832
ad_spend	24187
anarix_id	0
units	17898
unit_price	0

Preprocessing

```
import pandas as pd

train_data['date'] = pd.to_datetime(train_data['date'])
train_data.set_index('date', inplace=True)
train_data.interpolate(method='linear', limit_direction='both', inplace=True)

train_data.info()
train_data.head()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 101490 entries, 2022-04-12 to 2024-05-31
Data columns (total 7 columns):
 #   Column      Non-Null Count   Dtype
---  ------      --------------   -----
 0   ID          101490 non-null  object
 1   Item Id     101488 non-null  object
 2   Item Name   99658 non-null   object
 3   ad_spend    101490 non-null  float64
 4   anarix_id   101490 non-null  object
 5   units       101490 non-null  float64
 6   unit_price  101490 non-null  float64
dtypes: float64(3), object(4)
memory usage: 6.2+ MB
<ipython-input-69-3c300824b85b>:5: FutureWarning: DataFrame.interpolate with object dtype is deprecated and will raise in a future
  train_data.interpolate(method='linear', limit_direction='both', inplace=True)
```

date	ID	Item Id	Item Name	ad_spend	anarix_id	units	unit_price
2022-04-12	2022-04-12_B09KDTS4DC	B09KDTS4DC	NapQueen Elizabeth 8" Gel Memory Foam Mattress...	0.0	NAPQUEEN	0.0	0.0
2022-04-12	2022-04-12_B09MR2MLZH	B09MR2MLZH	NapQueen 12 Inch Bamboo Charcoal Queen Size Me...	0.0	NAPQUEEN	0.0	0.0
2022-04-12	2022-04-12_B09KSYL73R	B09KSYL73R	NapQueen Elsa 8" Innerspring Mattress, Twin XL	0.0	NAPQUEEN	0.0	0.0
2022-04-	2022-04-		NapQueen Elsa 6" Innerspring Mattress				

```
train_data.isnull().sum()
```

	0
ID	0
Item Id	2
Item Name	1832
ad_spend	0
anarix_id	0
units	0
unit_price	0

Since the Null values in Item Id and name are less than 1% of the data, we dropped the corrosponding rows for further processing

```
train_data.dropna(subset=['Item Id', 'Item Name'], inplace=True)
print(train_data.info())
print(train_data.head())
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 99658 entries, 2022-04-12 to 2024-05-31
Data columns (total 7 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   ID          99658 non-null  object
 1   Item Id     99658 non-null  object
 2   Item Name   99658 non-null  object
 3   ad_spend    99658 non-null  float64
 4   anarix_id   99658 non-null  object
 5   units       99658 non-null  float64
 6   unit_price  99658 non-null  float64
dtypes: float64(3), object(4)
memory usage: 6.1+ MB
None
                              ID     Item Id  \
date
2022-04-12  2022-04-12_B09KDTS4DC  B09KDTS4DC
2022-04-12  2022-04-12_B09MR2MLZH  B09MR2MLZH
2022-04-12  2022-04-12_B09KSYL73R  B09KSYL73R
2022-04-12  2022-04-12_B09KT5HMNY  B09KT5HMNY
2022-04-12  2022-04-12_B09KTF8ZDQ  B09KTF8ZDQ

                                            Item Name  ad_spend  \
date
2022-04-12  NapQueen Elizabeth 8" Gel Memory Foam Mattress...       0.0
2022-04-12  NapQueen 12 Inch Bamboo Charcoal Queen Size Me...       0.0
2022-04-12     NapQueen Elsa 8" Innerspring Mattress, Twin XL       0.0
2022-04-12        NapQueen Elsa 6" Innerspring Mattress, Twin       0.0
```

```
2022-04-12     NapQueen Elsa 6" Innerspring Mattress, Twin XL       0.0
```

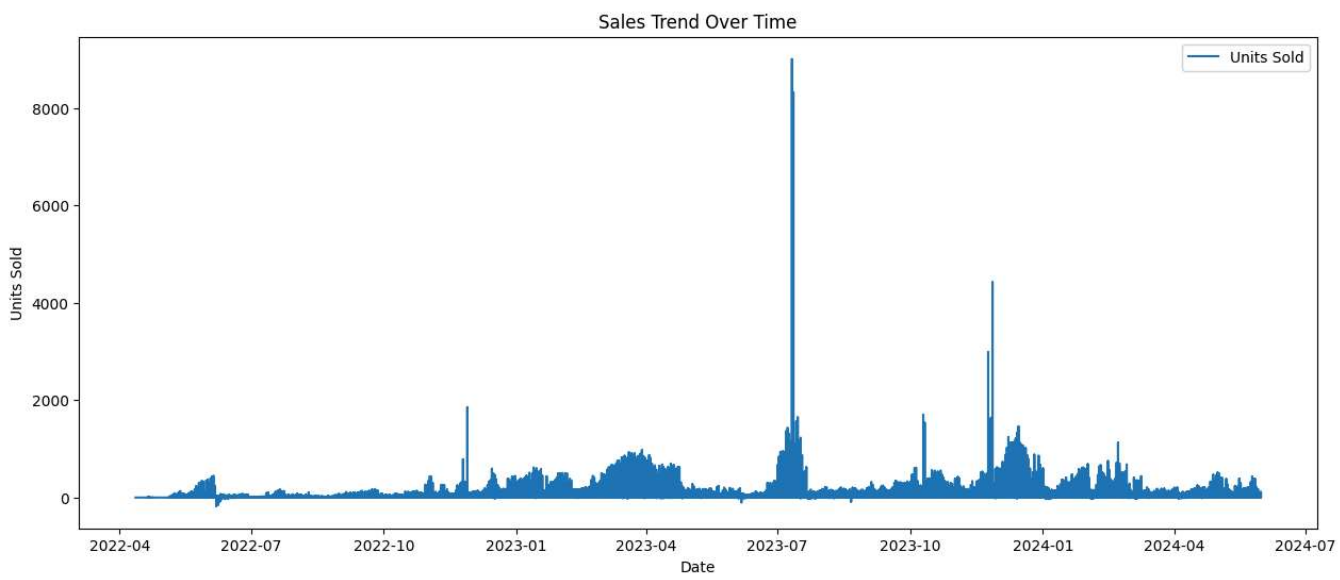
```
           anarix_id  units  unit_price
date
2022-04-12  NAPQUEEN    0.0         0.0
2022-04-12  NAPQUEEN    0.0         0.0
2022-04-12  NAPQUEEN    0.0         0.0
2022-04-12  NAPQUEEN    0.0         0.0
2022-04-12  NAPQUEEN    0.0         0.0
```

```
train_data.isnull().sum()
```

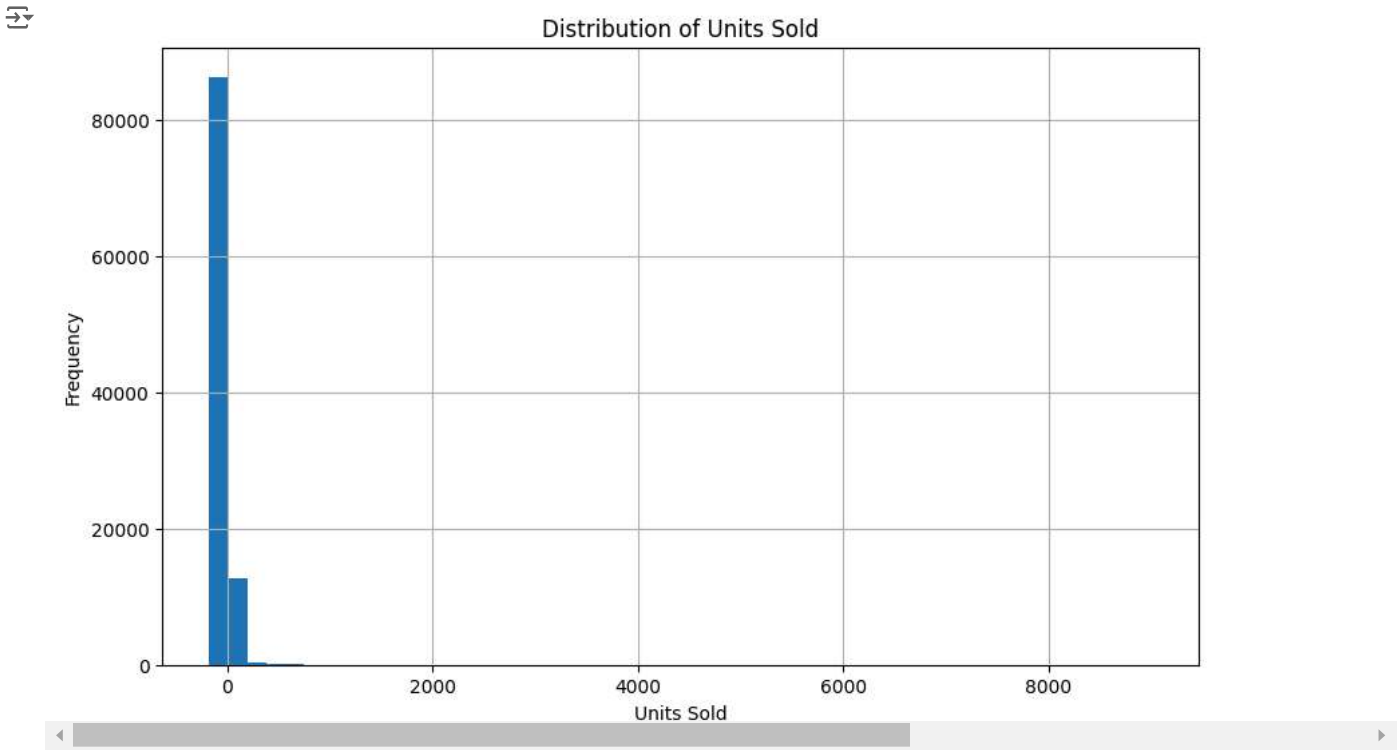
	0
ID	0
Item Id	0
Item Name	0
ad_spend	0
anarix_id	0
units	0
unit_price	0

Visualising the cleaned Data

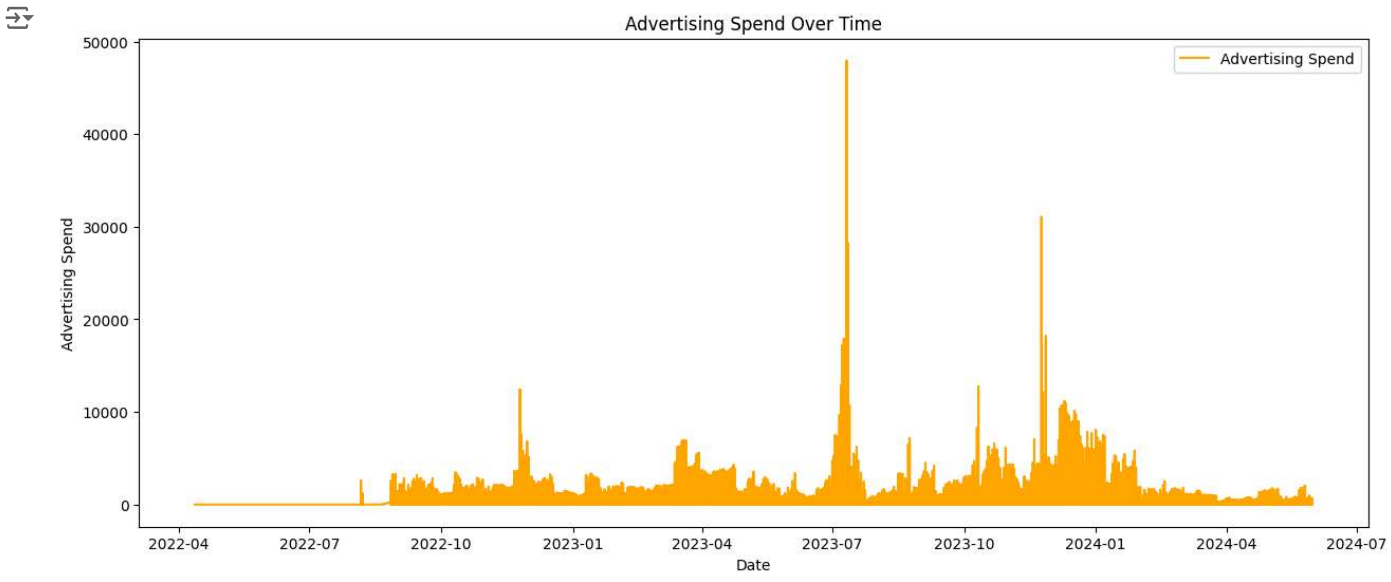
```
import matplotlib.pyplot as plt
plt.figure(figsize=(15, 6))
plt.plot(train_data.index, train_data['units'], label='Units Sold')
plt.xlabel('Date')
plt.ylabel('Units Sold')
plt.title('Sales Trend Over Time')
plt.legend()
plt.show()
```



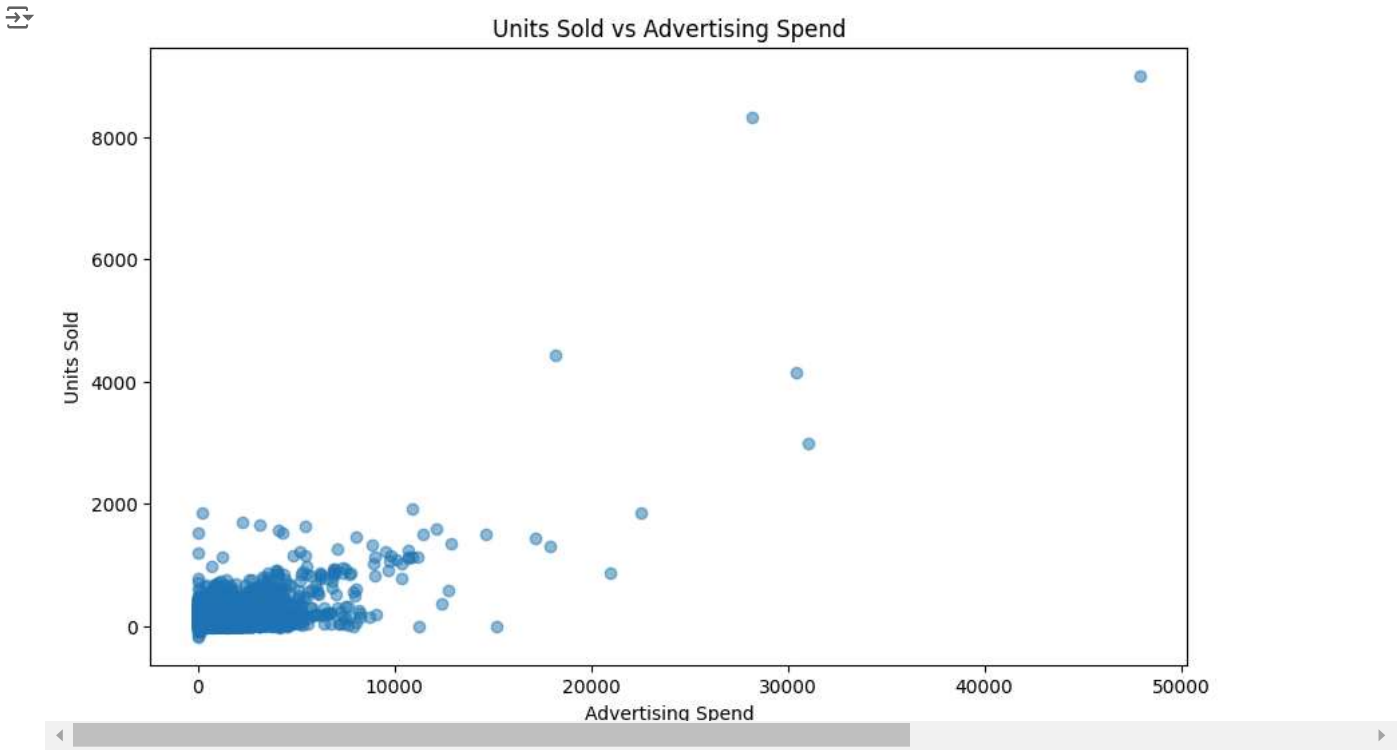

```
plt.figure(figsize=(10, 6))
train_data['units'].hist(bins=50)
plt.xlabel('Units Sold')
plt.ylabel('Frequency')
plt.title('Distribution of Units Sold')
plt.show()
```




```
plt.figure(figsize=(15, 6))
plt.plot(train_data.index, train_data['ad_spend'], label='Advertising Spend', color='orange')
plt.xlabel('Date')
plt.ylabel('Advertising Spend')
plt.title('Advertising Spend Over Time')
plt.legend()
plt.show()
```



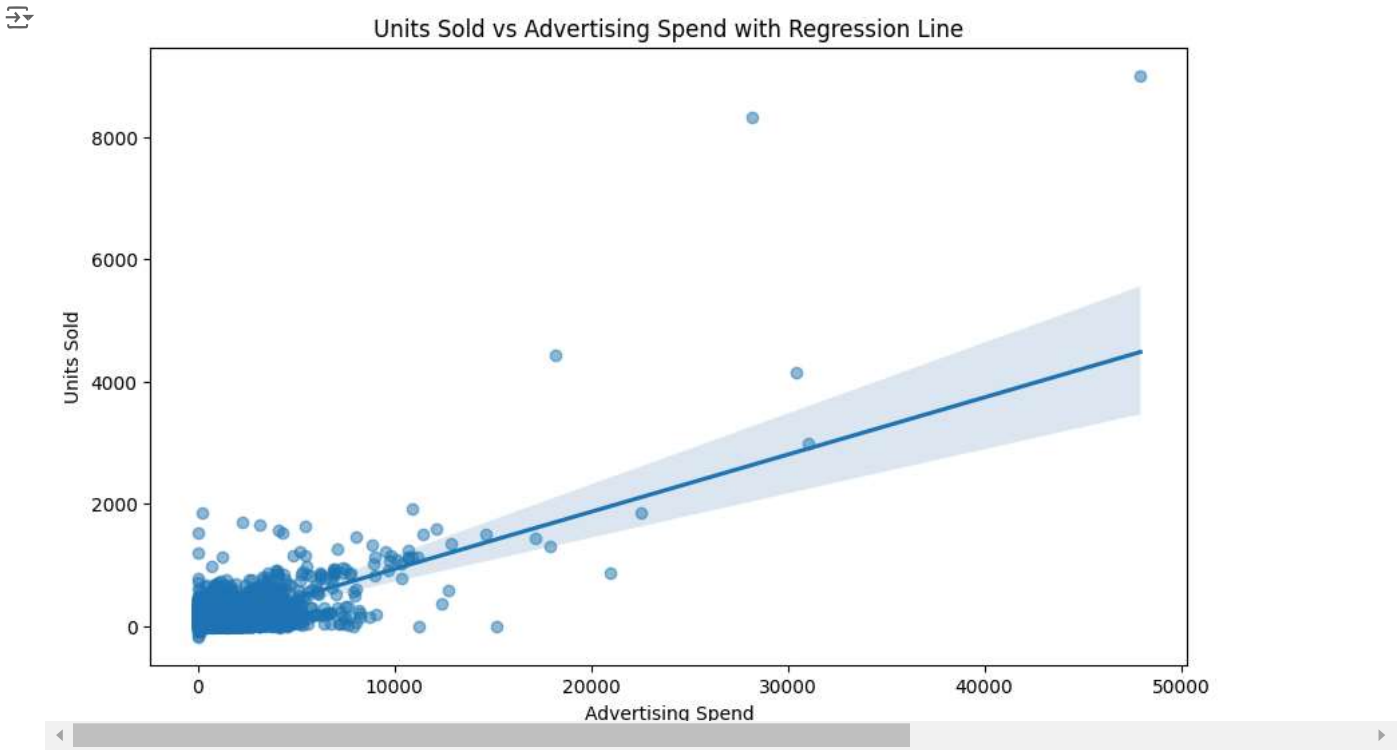

```
plt.figure(figsize=(10, 6))
plt.scatter(train_data['ad_spend'], train_data['units'], alpha=0.5)
plt.xlabel('Advertising Spend')
plt.ylabel('Units Sold')
plt.title('Units Sold vs Advertising Spend')
plt.show()
```




```
correlation = train_data['ad_spend'].corr(train_data['units'])
print(f'Correlation: {correlation}')
```

```
Correlation: 0.7150979326355272
```

```
import seaborn as sns
plt.figure(figsize=(10, 6))
sns.regplot(x='ad_spend', y='units', data=train_data, scatter_kws={'alpha':0.5})
plt.xlabel('Advertising Spend')
plt.ylabel('Units Sold')
plt.title('Units Sold vs Advertising Spend with Regression Line')
plt.show()
```



```
import numpy as np
from sklearn.preprocessing import MinMaxScaler
features = ['units', 'ad_spend']
scaler = MinMaxScaler()
scaled_data = scaler.fit_transform(train_data[features])
scaled_data = pd.DataFrame(scaled_data, index=train_data.index, columns=features)
scaled_data.head()
```

date	units	ad_spend
2022-04-12	0.018851	0.0
2022-04-12	0.018851	0.0
2022-04-12	0.018851	0.0
2022-04-12	0.018851	0.0
2022-04-12	0.018851	0.0

Next steps: Generate code with `scaled_data` | View recommended plots | New interactive sheet

```
def create_sequences(data, seq_length):
    sequences = []
    labels = []
    for i in range(len(data) - seq_length):
        seq = data[i:i+seq_length]
        label = data[i+seq_length][0]  # Predicting 'units'
        sequences.append(seq)
        labels.append(label)
    return np.array(sequences), np.array(labels)
SEQ_LENGTH = 30
sequences, labels = create_sequences(scaled_data.values, SEQ_LENGTH)
split = int(0.8 * len(sequences))
train_sequences = sequences[:split]
train_labels = labels[:split]
val_sequences = sequences[split:]
val_labels = labels[split:]

train_sequences.shape, train_labels.shape, val_sequences.shape, val_labels.shape
```

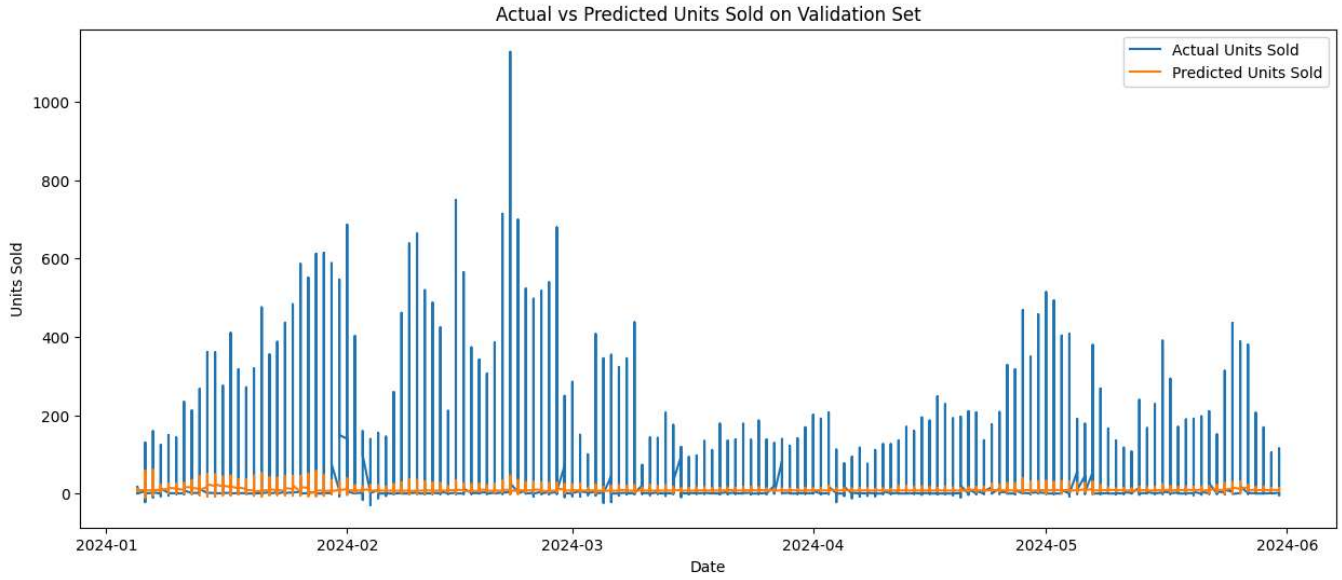
```
((79702, 30, 2), (79702,), (19926, 30, 2), (19926,))
```

```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense, Dropout
model = Sequential()
model.add(LSTM(50, return_sequences=True, input_shape=(SEQ_LENGTH, len(features))))
model.add(Dropout(0.2))
model.add(LSTM(50, return_sequences=False))
model.add(Dropout(0.2))
model.add(Dense(1))
model.compile(optimizer='adam', loss='mean_squared_error')
history = model.fit(train_sequences, train_labels, epochs=5, batch_size=32, validation_data=(val_sequences, val_labels))
```

```
Epoch 1/5
/usr/local/lib/python3.10/dist-packages/keras/src/layers/rnn/rnn.py:204: UserWarning: Do not pass an `input_shape`/`input_dim` argu
  super().__init__(**kwargs)
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 91s 35ms/step - loss: 7.0100e-05 - val_loss: 1.5201e-05
Epoch 2/5
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 81s 33ms/step - loss: 5.5484e-05 - val_loss: 1.5134e-05
Epoch 3/5
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 83s 33ms/step - loss: 3.6199e-05 - val_loss: 1.5149e-05
Epoch 4/5
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 138s 32ms/step - loss: 9.0451e-05 - val_loss: 1.5570e-05
Epoch 5/5
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 82s 32ms/step - loss: 4.7277e-05 - val_loss: 1.5007e-05
```

```
from sklearn.metrics import mean_squared_error
val_predictions = model.predict(val_sequences)
val_predictions = scaler.inverse_transform(np.concatenate((val_predictions, np.zeros((val_predictions.shape[0], 1))), axis=1))[:,0]
val_labels = scaler.inverse_transform(np.concatenate((val_labels.reshape(-1, 1), np.zeros((val_labels.shape[0], 1))), axis=1))[:,0]
mse = mean_squared_error(val_labels, val_predictions)
print(f'Mean Squared Error (MSE) on validation set: {mse}')
plt.figure(figsize=(15, 6))
plt.plot(train_data.index[SEQ_LENGTH:][split:], val_labels, label='Actual Units Sold')
plt.plot(train_data.index[SEQ_LENGTH:][split:], val_predictions, label='Predicted Units Sold')
plt.xlabel('Date')
plt.ylabel('Units Sold')
plt.title('Actual vs Predicted Units Sold on Validation Set')
plt.legend()
plt.show()
```

```
623/623 ━━━━━━━━━━━━━━━━━━━━ 6s 9ms/step
Mean Squared Error (MSE) on validation set: 1263.823382827674
```



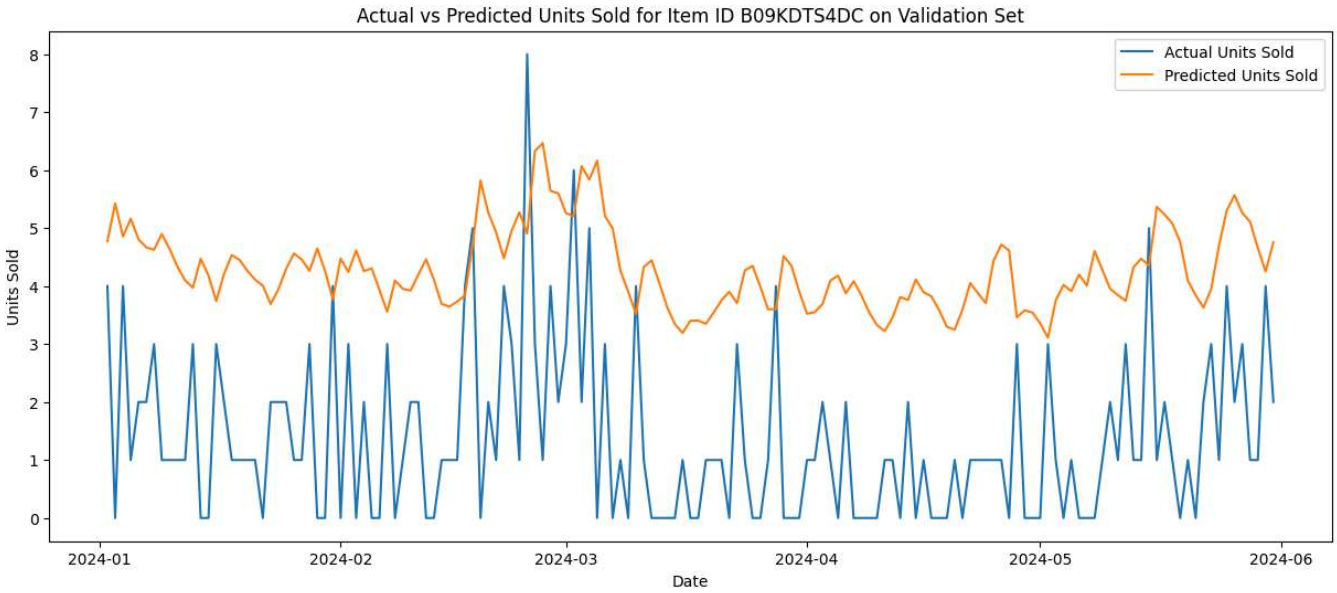
Evaluation using Specific Item ID

```
item_id = 'B09KDTS4DC'  # Replace with the desired Item ID
item_data = train_data[train_data['Item Id'] == item_id]
if len(item_data) > SEQ_LENGTH:
    print(f'Number of records for Item ID {item_id}: {len(item_data)}')
else:
    print('Not enough data')
```

```
Number of records for Item ID B09KDTS4DC: 780
```

```
item_scaled_data = scaler.fit_transform(item_data[features])
item_scaled_data = pd.DataFrame(item_scaled_data, index=item_data.index, columns=features)
item_sequences, item_labels = create_sequences(item_scaled_data.values, SEQ_LENGTH)
split = int(0.8 * len(item_sequences))
item_train_sequences = item_sequences[:split]
item_train_labels = item_labels[:split]
item_val_sequences = item_sequences[split:]
item_val_labels = item_labels[split:]
item_model = Sequential()
item_model.add(LSTM(50, return_sequences=True, input_shape=(SEQ_LENGTH, len(features))))
item_model.add(Dropout(0.2))
item_model.add(LSTM(50, return_sequences=False))
item_model.add(Dropout(0.2))
item_model.add(Dense(1))
item_model.compile(optimizer='adam', loss='mean_squared_error')
item_model.fit(item_train_sequences, item_train_labels, epochs=20, batch_size=32, validation_data=(item_val_sequences, item_val_labels)
item_val_predictions = item_model.predict(item_val_sequences)
item_val_predictions = scaler.inverse_transform(np.concatenate((item_val_predictions, np.zeros((item_val_predictions.shape[0], 1))), ax
item_val_labels = scaler.inverse_transform(np.concatenate((item_val_labels.reshape(-1, 1), np.zeros((item_val_labels.shape[0], 1))), ax
item_mse = mean_squared_error(item_val_labels, item_val_predictions)
print(f'Mean Squared Error (MSE) on validation set for Item ID {item_id}: {item_mse}')
plt.figure(figsize=(15, 6))
plt.plot(item_data.index[SEQ_LENGTH:][split:], item_val_labels, label='Actual Units Sold')
plt.plot(item_data.index[SEQ_LENGTH:][split:], item_val_predictions, label='Predicted Units Sold')
plt.xlabel('Date')
plt.ylabel('Units Sold')
plt.title(f'Actual vs Predicted Units Sold for Item ID {item_id} on Validation Set')
plt.legend()
plt.show()
```

```
Epoch 1/20
/usr/local/lib/python3.10/dist-packages/keras/src/layers/rnn/rnn.py:204: UserWarning: Do not pass an `input_shape`/`input_dim` argu
  super().__init__(**kwargs)
19/19 ━━━━━━━━━━━━━━━━━━━━ 4s 52ms/step - loss: 0.0046 - val_loss: 3.9741e-04
Epoch 2/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0072 - val_loss: 1.7429e-04
Epoch 3/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0035 - val_loss: 1.6623e-04
Epoch 4/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 31ms/step - loss: 0.0043 - val_loss: 1.8172e-04
Epoch 5/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0034 - val_loss: 1.0096e-04
Epoch 6/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 44ms/step - loss: 0.0059 - val_loss: 4.1750e-05
Epoch 7/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 51ms/step - loss: 0.0031 - val_loss: 1.5354e-04
Epoch 8/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 35ms/step - loss: 0.0025 - val_loss: 3.2192e-04
Epoch 9/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 29ms/step - loss: 0.0029 - val_loss: 2.7352e-04
Epoch 10/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 31ms/step - loss: 0.0026 - val_loss: 2.6083e-04
Epoch 11/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0035 - val_loss: 5.4291e-04
Epoch 12/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0029 - val_loss: 4.5396e-04
Epoch 13/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 32ms/step - loss: 0.0027 - val_loss: 3.4818e-04
Epoch 14/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 31ms/step - loss: 0.0049 - val_loss: 4.6694e-05
Epoch 15/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 32ms/step - loss: 0.0019 - val_loss: 1.1806e-04
Epoch 16/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0032 - val_loss: 4.5946e-05
Epoch 17/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0040 - val_loss: 4.5400e-05
Epoch 18/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0036 - val_loss: 5.1686e-05
Epoch 19/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 29ms/step - loss: 0.0028 - val_loss: 2.2085e-04
Epoch 20/20
19/19 ━━━━━━━━━━━━━━━━━━━━ 1s 30ms/step - loss: 0.0028 - val_loss: 2.2120e-04
5/5 ━━━━━━━━━━━━━━━━━━━━ 1s 76ms/step
Mean Squared Error (MSE) on validation set for Item ID B09KDTS4DC: 10.608871689446715
```



Using the whole train data to predict test Data

```
import pandas as pd
import numpy as np
from sklearn.preprocessing import MinMaxScaler
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense, Dropout
import matplotlib.pyplot as plt

train_data = pd.read_csv('train.csv')
```

```
test_data = pd.read_csv('test.csv')

train_data['date'] = pd.to_datetime(train_data['date'])
train_data.set_index('date', inplace=True)
train_data = train_data.infer_objects()  # Infer objects for interpolation
train_data.interpolate(method='linear', limit_direction='both', inplace=True)
train_data.dropna(subset=['Item Id', 'Item Name'], inplace=True)
features = ['units', 'ad_spend']
scaler = MinMaxScaler()
scaled_train_data = scaler.fit_transform(train_data[features])
scaled_train_data = pd.DataFrame(scaled_train_data, index=train_data.index, columns=features)
def create_sequences(data, seq_length):
    sequences = []
    labels = []
    for i in range(len(data) - seq_length):
        seq = data[i:i+seq_length]
        label = data[i+seq_length][0]
        sequences.append(seq)
        labels.append(label)
    return np.array(sequences), np.array(labels)
SEQ_LENGTH = 30
train_sequences, train_labels = create_sequences(scaled_train_data.values, SEQ_LENGTH)
split = int(0.8 * len(train_sequences))
train_sequences, val_sequences = train_sequences[:split], train_sequences[split:]
train_labels, val_labels = train_labels[:split], train_labels[split:]
model = Sequential()
model.add(tf.keras.Input(shape=(SEQ_LENGTH, len(features))))
model.add(LSTM(50, return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(50, return_sequences=False))
model.add(Dropout(0.2))
model.add(Dense(1))
model.compile(optimizer='adam', loss='mean_squared_error')
history = model.fit(train_sequences, train_labels, epochs=2, batch_size=32, validation_data=(val_sequences, val_labels))
test_data['date'] = pd.to_datetime(test_data['date'])
test_data.set_index('date', inplace=True)
test_data = test_data.infer_objects()
test_data.interpolate(method='linear', limit_direction='both', inplace=True)
test_data.dropna(subset=['Item Id', 'Item Name'], inplace=True)
test_scaled_data = test_data[['ad_spend']].copy()
test_scaled_data['units'] = 0
test_scaled_data = test_scaled_data[['units', 'ad_spend']]
scaled_test_data = scaler.transform(test_scaled_data)
def create_test_sequences(data, seq_length, initial_sequence):
    sequences = []
    current_sequence = initial_sequence
    for i in range(len(data)):
        next_sequence = np.append(current_sequence[1:], [data[i]], axis=0)
        sequences.append(next_sequence)
        current_sequence = next_sequence
    return np.array(sequences)
initial_sequence = scaled_train_data.values[-SEQ_LENGTH:]
test_sequences = create_test_sequences(scaled_test_data, SEQ_LENGTH, initial_sequence)
test_predictions = model.predict(test_sequences)
test_predictions = scaler.inverse_transform(np.concatenate((test_predictions, np.zeros((test_predictions.shape[0], 1))), axis=1))[:, 0]
test_data['Predicted Units'] = test_predictions
test_data.to_csv('test_predictions.csv')

print(f'Test predictions saved to test_predictions.csv')
plt.figure(figsize=(15, 6))
plt.plot(test_data.index, test_data['Predicted Units'], label='Predicted Units Sold', linestyle='dashed')
plt.xlabel('Date')
plt.ylabel('Units Sold')
plt.title('Predicted Units Sold on Test Set')
plt.legend()
plt.show()
```

```
<ipython-input-85-a1a3b024e13b>:15: FutureWarning: DataFrame.interpolate with object dtype is deprecated and will raise in a future
  train_data.interpolate(method='linear', limit_direction='both', inplace=True)
Epoch 1/2
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 80s 30ms/step - loss: 9.7083e-05 - val_loss: 1.5055e-05
Epoch 2/2
2491/2491 ━━━━━━━━━━━━━━━━━━━━ 88s 33ms/step - loss: 3.8864e-05 - val_loss: 1.4973e-05
<ipython-input-85-a1a3b024e13b>:47: FutureWarning: DataFrame.interpolate with object dtype is deprecated and will raise in a future
  test_data.interpolate(method='linear', limit_direction='both', inplace=True)
WARNING:tensorflow:5 out of the last 629 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_distr
```