SUDA NAVEEN 20MIC0057 Forecasting Unit Sales

Importing required files

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import GridSearchCV
import xgboost as xgb
import warnings
warnings.filterwarnings("ignore")
```

loading data

```
train_df = pd.read_csv('train.csv', parse_dates=['date'])
test_df = pd.read_csv('test.csv', parse_dates=['date'])
```

preprocessing

```
train_df.info()
train_df.describe()
train_df.isnull().sum()
```

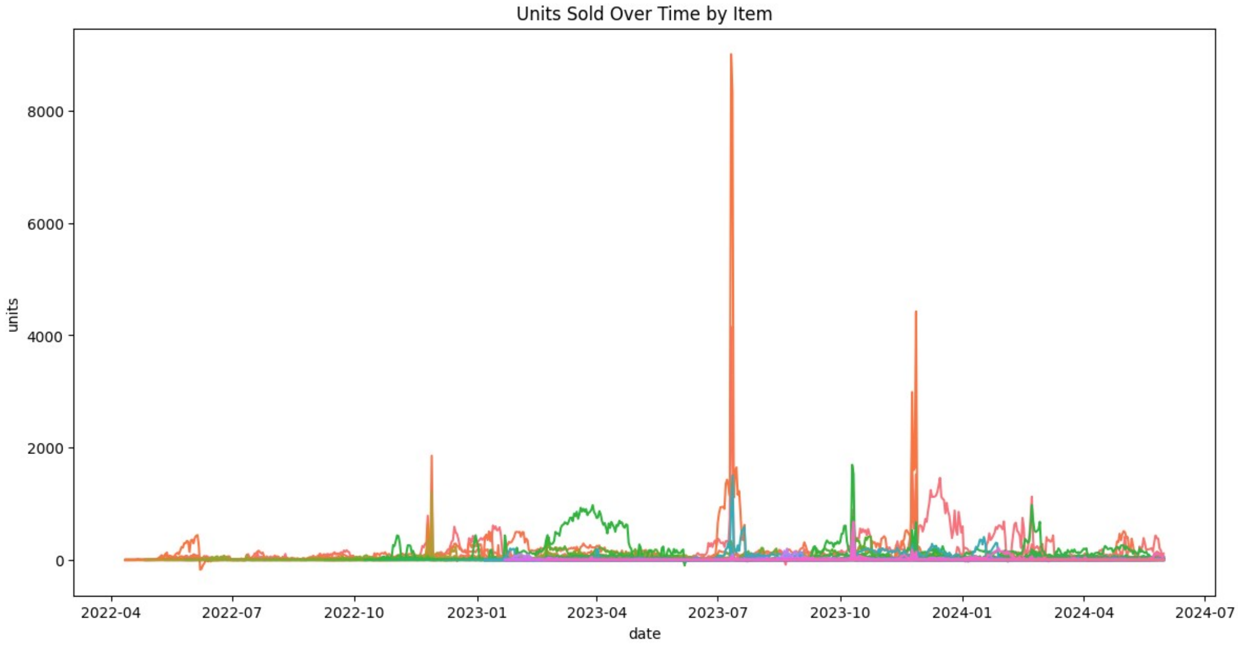
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 101490 entries, 0 to 101489
Data columns (total 8 columns):
 #   Column      Non-Null Count   Dtype
---  ------      --------------   -----
 0   ID          101490 non-null  object
 1   date        101490 non-null  datetime64[ns]
 2   Item Id     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: datetime64[ns](1), float64(3), object(4)
memory usage: 6.2+ MB
```

```
ID                 0
date               0
Item Id            2
Item Name       1832
ad_spend       24187
anarix_id          0
```

```
units          17898
unit_price         0
dtype: int64
```

visualization salse and time

```
plt.figure(figsize=(14, 7))
sns.lineplot(data=train_df, x='date', y='units', hue='Item Id',
legend=None)
plt.title('Units Sold Over Time by Item')
plt.show()
```



```
train_df['year'] = train_df['date'].dt.year
train_df['month'] = train_df['date'].dt.month
train_df['day'] = train_df['date'].dt.day
train_df['dayofweek'] = train_df['date'].dt.dayofweek

test_df['year'] = test_df['date'].dt.year
test_df['month'] = test_df['date'].dt.month
test_df['day'] = test_df['date'].dt.day
test_df['dayofweek'] = test_df['date'].dt.dayofweek

train_df_grouped = train_df.groupby(['Item Id', 'year', 'month',
'day', 'dayofweek']).agg({
    'ad_spend': 'sum',
    'units': 'sum',
    'unit_price': 'mean'
}).reset_index()
```

```
test_df_grouped = test_df.groupby(['Item Id', 'year', 'month', 'day',
'dayofweek']).agg({
    'ad_spend': 'sum',
    'unit_price': 'mean'
}).reset_index()
```

model selection

```
X = train_df_grouped.drop(columns=['units'])
y = train_df_grouped['units']

X_test = test_df_grouped.copy()

X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.2,
random_state=42)

scaler = StandardScaler()

X_train_scaled = scaler.fit_transform(X_train[['ad_spend',
'unit_price']])
X_val_scaled = scaler.transform(X_val[['ad_spend', 'unit_price']])
X_test_scaled = scaler.transform(X_test[['ad_spend', 'unit_price']])

X_train_scaled = pd.DataFrame(X_train_scaled, columns=['ad_spend',
'unit_price'])
X_val_scaled = pd.DataFrame(X_val_scaled, columns=['ad_spend',
'unit_price'])
X_test_scaled = pd.DataFrame(X_test_scaled, columns=['ad_spend',
'unit_price'])
```

training

```
model = xgb.XGBRegressor(objective='reg:squarederror',
random_state=42)
model.fit(X_train_scaled, y_train)
```

```
XGBRegressor(base_score=None, booster=None, callbacks=None,
             colsample_bylevel=None, colsample_bynode=None,
             colsample_bytree=None, device=None,
early_stopping_rounds=None,
             enable_categorical=False, eval_metric=None,
feature_types=None,
             gamma=None, grow_policy=None, importance_type=None,
             interaction_constraints=None, learning_rate=None,
max_bin=None,
             max_cat_threshold=None, max_cat_to_onehot=None,
             max_delta_step=None, max_depth=None, max_leaves=None,
             min_child_weight=None, missing=nan,
monotone_constraints=None,
             multi_strategy=None, n_estimators=None, n_jobs=None,
             num_parallel_tree=None, random_state=42, ...)
```

Hyperparameter Tuning

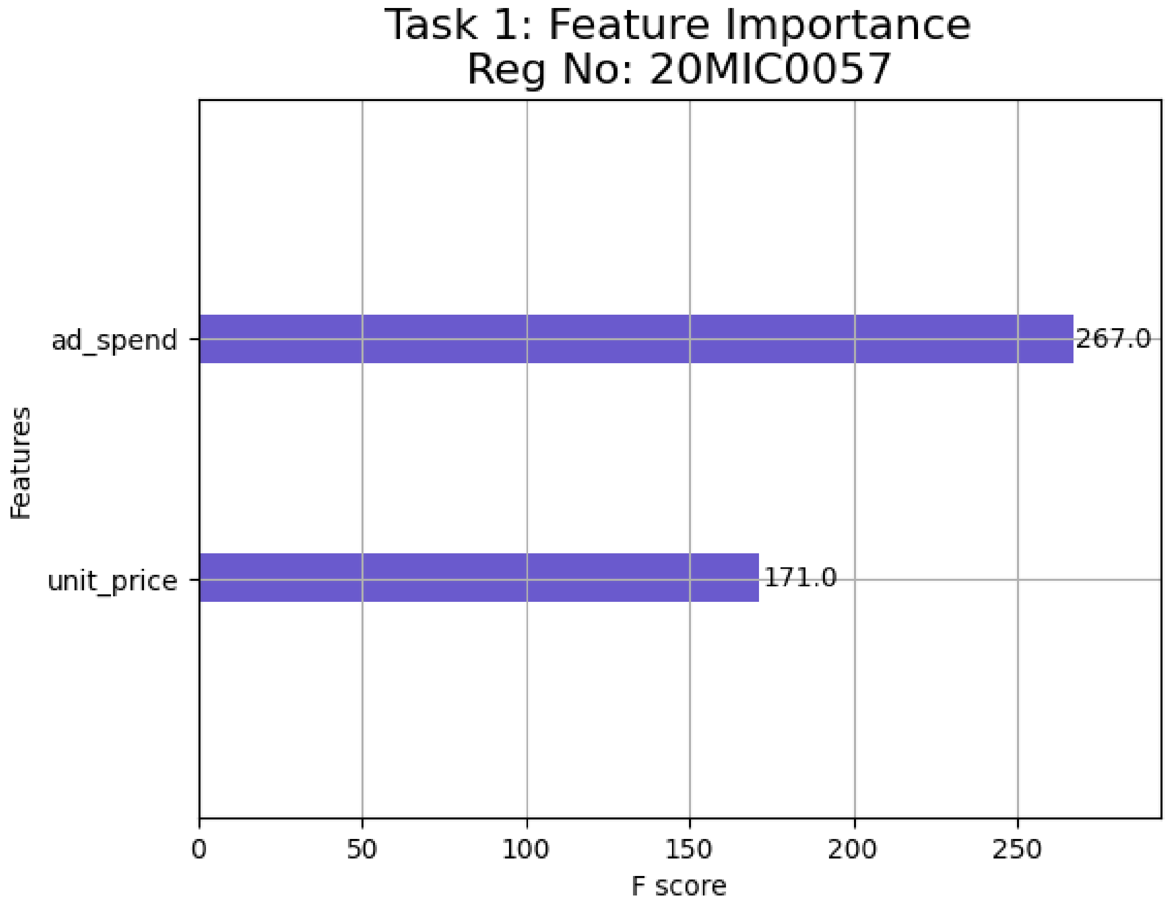
```
param_grid = {
    'n_estimators': [100, 200],
    'max_depth': [3, 6, 9],
    'learning_rate': [0.01, 0.1, 0.3],
    'subsample': [0.8, 1.0]
}

grid_search = GridSearchCV(estimator=model, param_grid=param_grid,
cv=3, scoring='neg_mean_squared_error', verbose=1)
grid_search.fit(X_train_scaled, y_train)

# Best model
best_model = grid_search.best_estimator_

Fitting 3 folds for each of 36 candidates, totalling 108 fits
```

evaluation

```
y_val_pred = best_model.predict(X_val_scaled)
mse = mean_squared_error(y_val, y_val_pred)
print(f"Validation MSE: {mse}")

Validation MSE: 800.3696653707689
```

Feature Importance vis

```
xgb.plot_importance(best_model, max_num_features=10,
importance_type='weight', color='slateblue')
plt.title('Task 1: Feature Importance\nReg No: 20MIC0057',
fontsize=16)
plt.show()
```



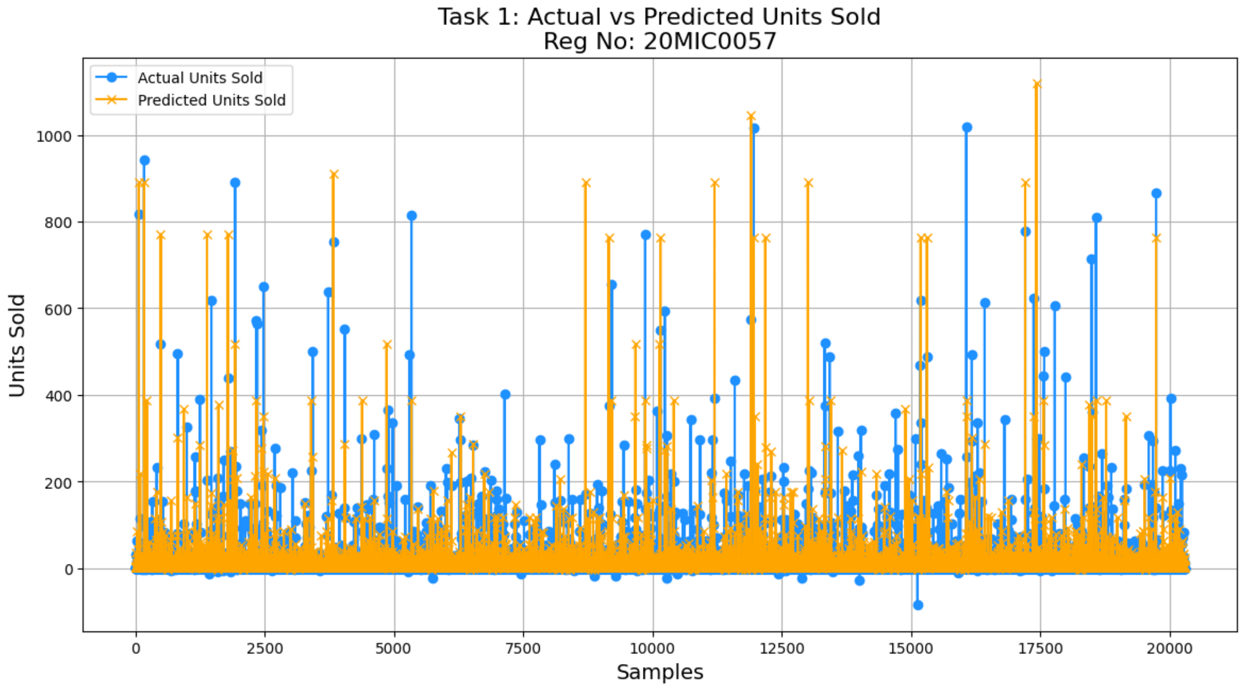
predictions

```
y_test_pred = best_model.predict(X_test_scaled)

submission = test_df[['date', 'Item Id']].copy()
submission['TARGET'] = y_test_pred
print(submission.head(15))
"""print(submission.to_csv('submission.csv', index=False)"""

          date     Item Id     TARGET
0   2024-07-01  B09KDR64LT  17.201189
1   2024-07-01  B09KDTS4DC   5.735999
2   2024-07-01  B09KDTHJ6V  13.156240
3   2024-07-01  B09KDQ2BWY  17.122910
4   2024-07-01  B09KDYY3SB   1.264941
5   2024-07-01  B09KDNYCYR   1.264941
6   2024-07-01  B09KDN7PYR   1.264941
7   2024-07-01  B09KDLQ2GW   1.264941
8   2024-07-01  B0BDRTZTGX   1.264941
9   2024-07-01  B09KDVXTP4   1.264941
10  2024-07-01  B09KDPXYG3   1.264941
11  2024-07-01  B09KDW1YKQ   1.264941
```

```
12 2024-07-01  B09MR36MLJ  17.201189
13 2024-07-01  B09KDZQJ6P   1.264941
14 2024-07-01  B09MR3Y296   3.241009

"print(submission.to_csv('submission.csv', index=False)"
```

Predicted vs Actual

```
plt.figure(figsize=(14, 7))
plt.plot(y_val.values, label='Actual Units Sold', color='dodgerblue', 
marker='o')
plt.plot(y_val_pred, label='Predicted Units Sold', color='orange', 
marker='x')
plt.title('Task 1: Actual vs Predicted Units Sold\nReg No: 20MIC0057', 
fontsize=16)
plt.xlabel('Samples', fontsize=14)
plt.ylabel('Units Sold', fontsize=14)
plt.legend()
plt.grid(True)
plt.show()
```


Task 1: Actual vs Predicted Units Sold
Reg No: 20MIC0057

Task 2: Predict Without unit sales without using ad spend data

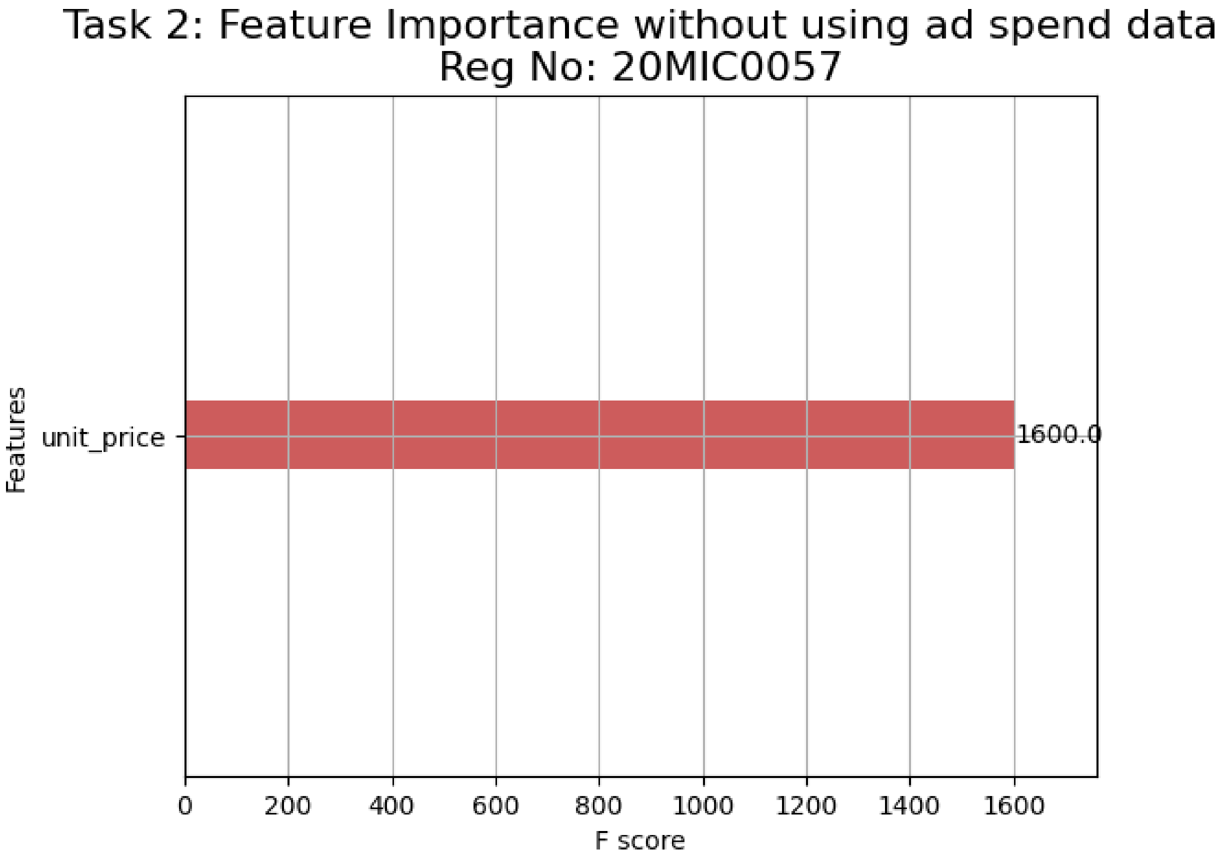
```
# drop ad_spend column
X_train_no_ad = X_train_scaled.drop(columns=['ad_spend'])
X_val_no_ad = X_val_scaled.drop(columns=['ad_spend'])
X_test_no_ad = X_test_scaled.drop(columns=['ad_spend'])
```

```python
# model without ad spend
model_no_ad = xgb.XGBRegressor(objective='reg:squarederror',
random_state=42)
model_no_ad.fit(X_train_no_ad, y_train)

y_val_no_ad_pred = model_no_ad.predict(X_val_no_ad)
mse_no_ad = mean_squared_error(y_val, y_val_no_ad_pred)
print(f"Validation MSE without ad_spend: {mse_no_ad}")

# Predict and show the results
y_test_no_ad_pred = model_no_ad.predict(X_test_no_ad)
submission_no_ad = test_df[['date', 'Item Id']].copy()
submission_no_ad['TARGET'] = y_test_no_ad_pred
print(submission_no_ad.head(15))
"""submission_no_ad.to_csv('submission_no_ad.csv', index=False)"""
```

```
Validation MSE without ad_spend: 1339.9913603024409
         date     Item Id     TARGET
0  2024-07-01  B09KDR64LT  28.154516
1  2024-07-01  B09KDTS4DC  43.566036
2  2024-07-01  B09KDTHJ6V  21.892855
3  2024-07-01  B09KDQ2BWY  25.312330
4  2024-07-01  B09KDYY3SB   2.973237
5  2024-07-01  B09KDNYCYR   2.973237
6  2024-07-01  B09KDN7PYR   2.973237
7  2024-07-01  B09KDLQ2GW   2.973237
8  2024-07-01  B0BDRTZTGX   2.973237
9  2024-07-01  B09KDVXTP4   2.973237
10 2024-07-01  B09KDPXYG3   2.973237
11 2024-07-01  B09KDW1YKQ   2.973237
12 2024-07-01  B09MR36MLJ  28.154516
13 2024-07-01  B09KDZQJ6P   2.973237
14 2024-07-01  B09MR3Y296  34.047482
```

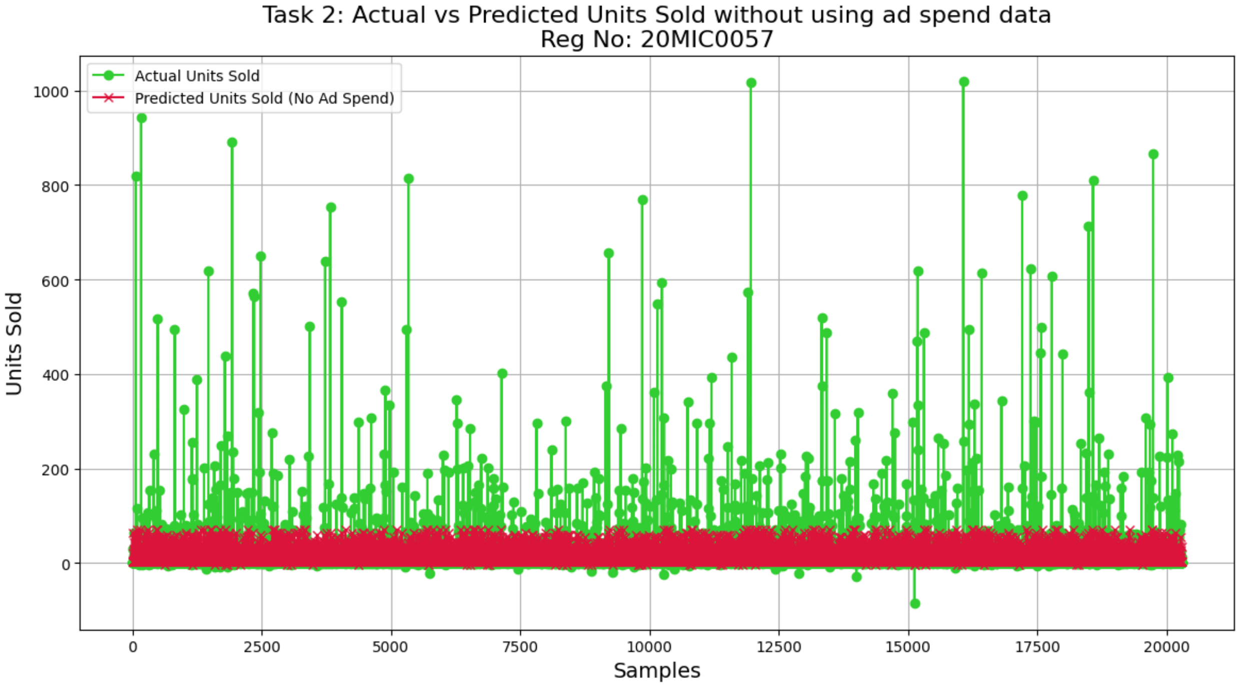
```
"submission_no_ad.to_csv('submission_no_ad.csv', index=False)"
```

```python
xgb.plot_importance(model_no_ad, max_num_features=10,
importance_type='weight', color='indianred')
plt.title('Task 2: Feature Importance without using ad spend data\nReg
No: 20MIC0057', fontsize=16)
plt.show()
```



Actual vs Predicted Units Sold without using ad spend data

```
plt.figure(figsize=(14, 7))
plt.plot(y_val.values, label='Actual Units Sold', color='limegreen',
marker='o')
plt.plot(y_val_no_ad_pred, label='Predicted Units Sold (No Ad Spend)',
color='crimson', marker='x')
plt.title('Task 2: Actual vs Predicted Units Sold without using ad
spend data\nReg No: 20MIC0057', fontsize=16)
plt.xlabel('Samples', fontsize=14)
plt.ylabel('Units Sold', fontsize=14)
plt.legend()
plt.grid(True)
plt.show()
```



Task 2: Actual vs Predicted Units Sold without using ad spend data
Reg No: 20MIC0057