Retail Sales Data set of Alcohol and Liquor

Introduction

This project analyzer a detailed dataset of alcohol sales (2017-2020), including wine, liquor, and beers. By examining monthly sales patterns, top-performing products, and supplier contributions. Predicting future demand, this analysis will help stakeholders maximize revenue and streamline operations.

Required Libraries

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np

from sklearn.impute import KNNImputer
from pylab import rcParams
from pathlib import Path

import seaborn as sns

from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression, Ridge, Lasso,
ElasticNet
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import  AdaBoostRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.metrics import mean_absolute_error, mean_squared_error,
r2_score
from sklearn.model_selection import GridSearchCV

import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
```

Load Dataset

```
# Create directory for images
Path("img").mkdir(parents=True, exist_ok=True)

# Set default figure size
rcParams['figure.figsize'] = (4, 4)

# Tell pandas how to display floats
pd.options.display.float_format = "{:,.2f}".format

path = 'Downloads/Warehouse_and_Retail_Sales.csv'
```

```
df = pd.read_csv(path, lineterminator='\n')
```

Initial Exploration

```
df.head()
```

```
   YEAR  MONTH                              SUPPLIER ITEM CODE  \
0  2020      1  REPUBLIC NATIONAL DISTRIBUTING CO    100009
1  2020      1                           PWSWN INC    100024
2  2020      1            RELIABLE CHURCHILL LLLP      1001
3  2020      1          LANTERNA DISTRIBUTORS INC    100145
4  2020      1               DIONYSOS IMPORTS INC    100293

                      ITEM DESCRIPTION ITEM TYPE  RETAIL SALES  \
0                  BOOTLEG RED - 750ML      WINE          0.00
1            MOMENT DE PLAISIR - 750ML      WINE          0.00
2  S SMITH ORGANIC PEAR CIDER - 18.7OZ      BEER          0.00
3        SCHLINK HAUS KABINETT - 750ML      WINE          0.00
4       SANTORINI GAVALA WHITE - 750ML      WINE          0.82

   RETAIL TRANSFERS  WAREHOUSE SALES
0              0.00              2.00
1              1.00              4.00
2              0.00              1.00
3              0.00              1.00
4              0.00              0.00
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 307645 entries, 0 to 307644
Data columns (total 9 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   YEAR              307645 non-null  int64
 1   MONTH             307645 non-null  int64
 2   SUPPLIER          307478 non-null  object
 3   ITEM CODE         307645 non-null  object
 4   ITEM DESCRIPTION  307645 non-null  object
 5   ITEM TYPE         307644 non-null  object
 6   RETAIL SALES      307642 non-null  float64
 7   RETAIL TRANSFERS  307645 non-null  float64
 8   WAREHOUSE SALES   307645 non-null  float64
dtypes: float64(3), int64(2), object(4)
memory usage: 21.1+ MB
```

```
df.isnull().sum()
```

```
YEAR                 0
MONTH                0
SUPPLIER           167
```

```
ITEM CODE              0
ITEM DESCRIPTION       0
ITEM TYPE              1
RETAIL SALES           3
RETAIL TRANSFERS       0
WAREHOUSE SALES        0
dtype: int64
```

```
df.shape
```

```
(307645, 9)
```

```
df.nunique()
```

```
YEAR                    4
MONTH                  12
SUPPLIER              396
ITEM CODE           34056
ITEM DESCRIPTION    34822
ITEM TYPE               8
RETAIL SALES        10674
RETAIL TRANSFERS     2504
WAREHOUSE SALES      4895
dtype: int64
```

```
df.dropna()
```

```
        YEAR  MONTH                              SUPPLIER ITEM CODE  \
0       2020      1  REPUBLIC NATIONAL DISTRIBUTING CO    100009
1       2020      1                           PWSWN INC    100024
2       2020      1           RELIABLE CHURCHILL LLLP      1001
3       2020      1         LANTERNA DISTRIBUTORS INC    100145
4       2020      1              DIONYSOS IMPORTS INC    100293
...      ...    ...                                ...       ...
307640  2020      9                           DOPS INC     97896
307641  2020      9               ANHEUSER BUSCH INC     97918
307642  2020      9                    HEINEKEN USA      97942
307643  2020      9           RELIABLE CHURCHILL LLLP     97950
307644  2020      9           RELIABLE CHURCHILL LLLP     97969

                                ITEM DESCRIPTION ITEM TYPE  RETAIL
SALES  \
0                            BOOTLEG RED - 750ML      WINE
0.00
1                      MOMENT DE PLAISIR - 750ML      WINE
0.00
2              S SMITH ORGANIC PEAR CIDER - 18.7OZ      BEER
0.00
3                    SCHLINK HAUS KABINETT - 750ML      WINE
0.00
4                   SANTORINI GAVALA WHITE - 750ML      WINE
```

```
0.82
...                                                  ...       ...
...
307640  ST PETERS ORGANIC ENG ALE NR 12/CS - 16.9OZ      BEER
0.00
307641               STELLA ARTOIS 2/12 NR - 11.2OZ      BEER
372.45
307642                        TECATE 4/6 LNNR - 12OZ      BEER
7.79
307643     S SMITH WINTER WELCOME NR 12/CS - 18.7OZ      BEER
0.00
307644          S SMITH WINTER WELCOME 4/6NR - 12OZ      BEER
0.00

        RETAIL TRANSFERS  WAREHOUSE SALES
0                   0.00             2.00
1                   1.00             4.00
2                   0.00             1.00
3                   0.00             1.00
4                   0.00             0.00
...                  ...              ...
307640              0.00             1.00
307641            315.00         3,586.88
307642              0.00             4.00
307643              0.00             2.00
307644              0.00             1.00

[307477 rows x 9 columns]
```

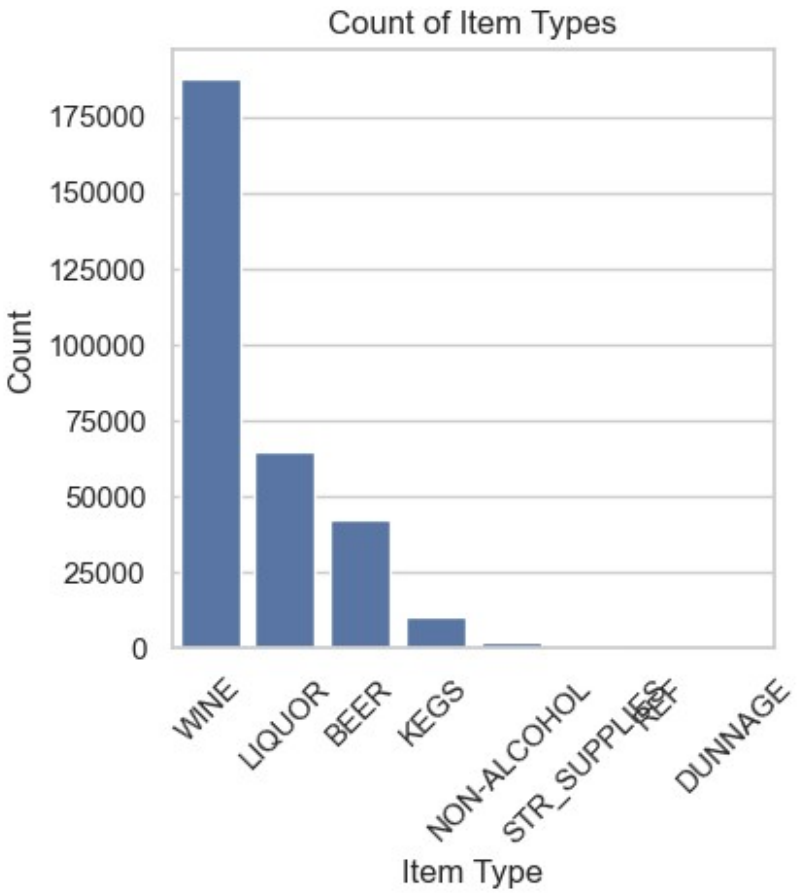
```
# Set style
sns.set(style="whitegrid")
plt.figure(figsize=(12, 6))
```

```
<Figure size 1200x600 with 0 Axes>
```

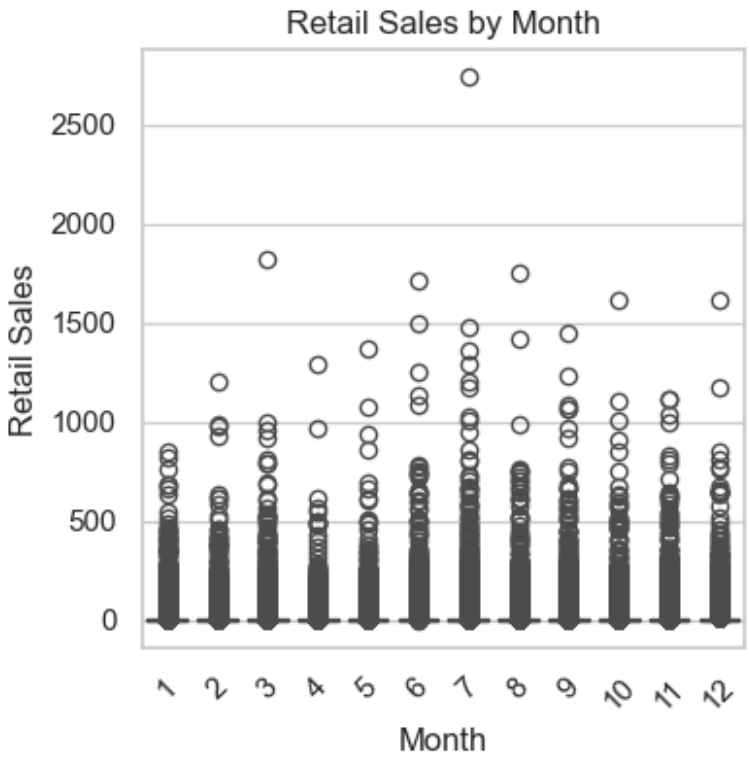
```
<Figure size 1200x600 with 0 Axes>
```

Visualizations

```
# Count of Item Types
sns.countplot(data=df, x="ITEM TYPE", order=df["ITEM
TYPE"].value_counts().index)
plt.title("Count of Item Types")
plt.xlabel("Item Type")
plt.ylabel("Count")
plt.xticks(rotation=45)
plt.show()
```




```
# Boxplot of Retail Sales by Month
sns.boxplot(data=df, x="MONTH", y="RETAIL SALES")
plt.title("Retail Sales by Month")
plt.xlabel("Month")
plt.ylabel("Retail Sales")
plt.xticks(rotation=45)
plt.show()
```

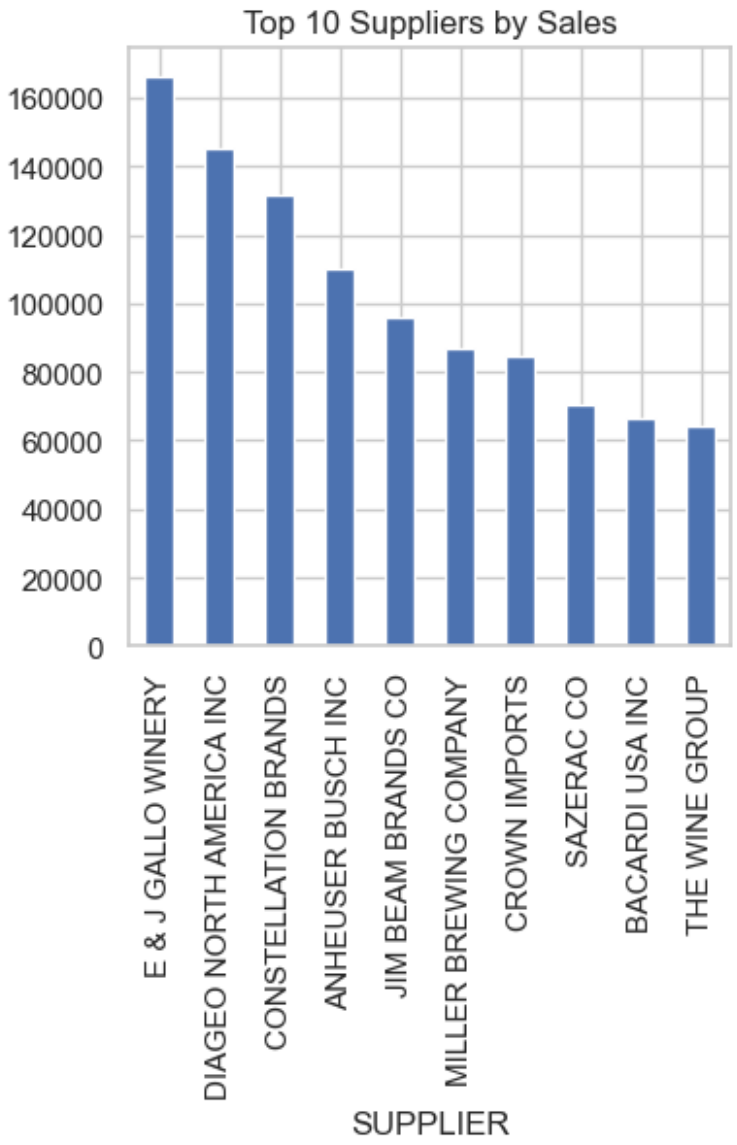



```
# Monthly Trend of Retail Sales
df['DATE'] = pd.to_datetime(df['YEAR'].astype(str) + '-' +
df['MONTH'].astype(str))
monthly_sales = df.groupby('DATE')['RETAIL SALES'].sum()
monthly_sales.plot(title="Monthly Retail Sales Trend")
```

```
<Axes: title={'center': 'Monthly Retail Sales Trend'}, xlabel='DATE'>
```

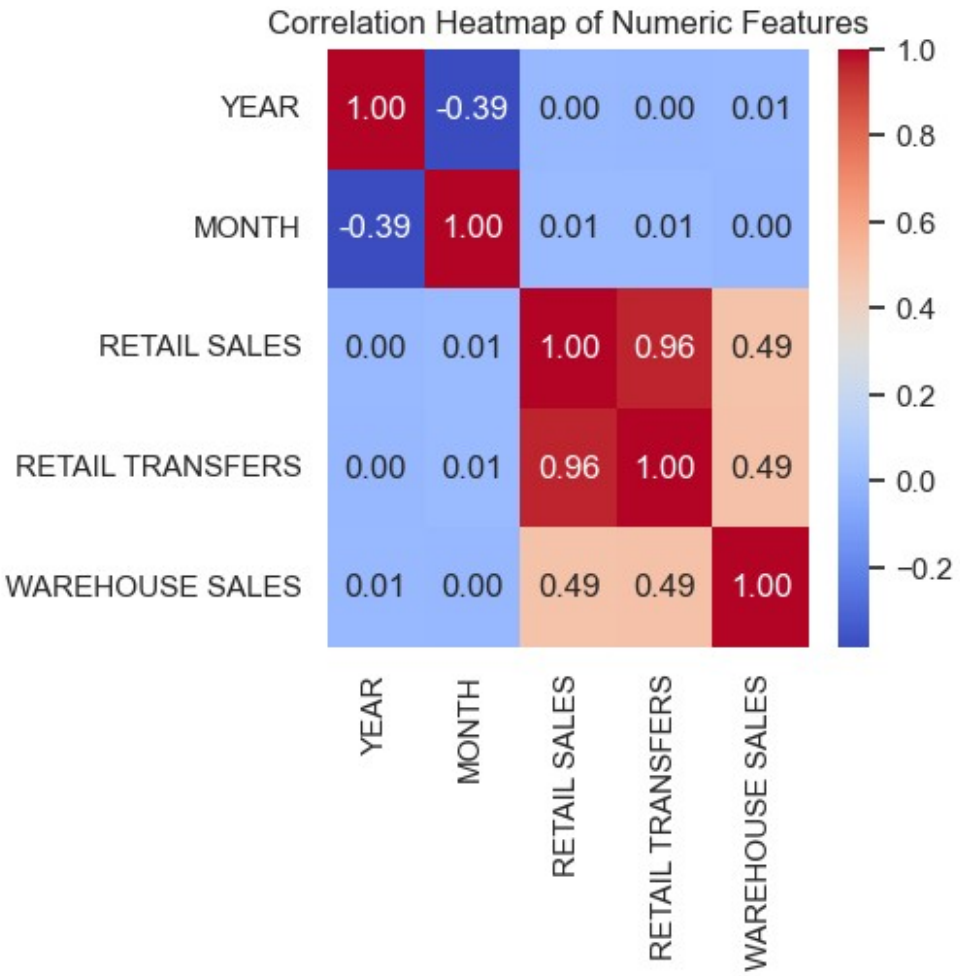

```
top_suppliers = df.groupby('SUPPLIER')['RETAIL
SALES'].sum().sort_values(ascending=False).head(10)
top_suppliers.plot(kind='bar', title="Top 10 Suppliers by Sales")
```

```
<Axes: title={'center': 'Top 10 Suppliers by Sales'},
xlabel='SUPPLIER'>
```

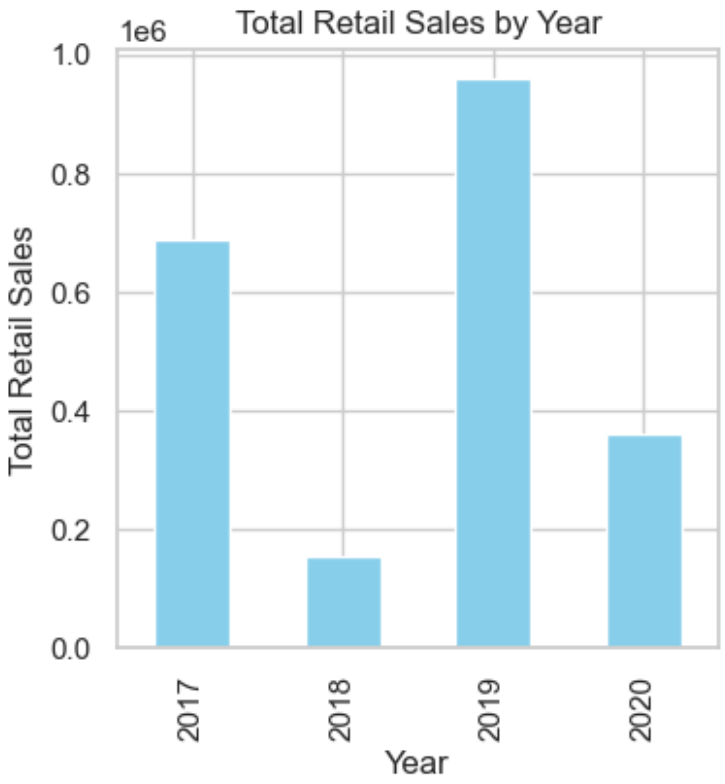



```
# Correlation Heat map (for numerical columns)
numeric_df = df.select_dtypes(include=[np.number])
print('Numeric columns in the dataset:', numeric_df.columns.tolist())


if numeric_df.shape[1] >= 4:
    corr = numeric_df.corr()
    sns.heatmap(corr, annot=True, cmap='coolwarm', fmt='.2f')
    plt.title('Correlation Heatmap of Numeric Features')
else:
    print('Not enough numeric columns to create a correlation
heatmap.')
```

```
Numeric columns in the dataset: ['YEAR', 'MONTH', 'RETAIL SALES',
'RETAIL TRANSFERS', 'WAREHOUSE SALES']
```




```
# Retail Sales by Year
yearly_sales = df.groupby("YEAR")["RETAIL SALES"].sum()
yearly_sales.plot(kind="bar", color="skyblue")
plt.title("Total Retail Sales by Year")
plt.xlabel("Year")
plt.ylabel("Total Retail Sales")

Text(0, 0.5, 'Total Retail Sales')
```



Modeling and Prediction

```
df_clean = df.drop(columns=["ITEM CODE", "ITEM DESCRIPTION"])

df['DATE'] = pd.to_datetime(df['YEAR'].astype(str) + '-' +
df['MONTH'].astype(str) + '-01', errors='coerce')

df_clean["MONTH_NUM"] = df_clean["DATE"].dt.month
df_clean["YEAR_NUM"] = df_clean["DATE"].dt.year
df_clean = df_clean.drop(columns=["DATE"])

le_supplier = LabelEncoder()
le_item_type = LabelEncoder()

df_clean["SUPPLIER_ENC"] =
le_supplier.fit_transform(df_clean["SUPPLIER"])
df_clean["ITEM_TYPE_ENC"] = le_item_type.fit_transform(df_clean["ITEM
TYPE"])

df_clean = df_clean.drop(columns=["SUPPLIER", "ITEM TYPE"])

target = "RETAIL SALES"

X = df_clean.drop(columns=[target])
y = df_clean[target]
```

```
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

X_train, X_test, y_train, y_test = train_test_split(X_scaled, y,
test_size=0.2, random_state=537)

valid_idx = ~np.isnan(y_train)
X_train, y_train = X_train[valid_idx], y_train[valid_idx]

valid_idx = ~np.isnan(y_test)
X_test, y_test = X_test[valid_idx], y_test[valid_idx]

def evaluate_model(name, model, X_train, y_train, X_test, y_test):
    model.fit(X_train, y_train)
    preds = model.predict(X_test)
    mae = mean_absolute_error(y_test, preds)
    mse = mean_squared_error(y_test, preds)
    rmse = np.sqrt(mse)
    r2 = r2_score(y_test, preds)
    return {
        "Model": name,
        "MAE": mae,
        "MSE": mse,
        "RMSE": rmse,
        "R²": r2
    }

models = [
    ("Linear Regression", LinearRegression()),
    ("Ridge", Ridge()),
    ("Lasso", Lasso()),
    ("ElasticNet", ElasticNet()),
    ("Decision Tree", DecisionTreeRegressor(max_depth=10)),
    ("AdaBoost", AdaBoostRegressor(n_estimators=50)),
    ("KNN", KNeighborsRegressor(n_neighbors=3)),
]

results = []
for name, model in models:
    score = evaluate_model(name, model, X_train, y_train, X_test,
y_test)
    results.append(score)

results_df = pd.DataFrame(results).sort_values("R²", ascending=False)
results_df
```

	Model	MAE	MSE	RMSE	R²
4	Decision Tree	1.66	36.26	6.02	0.95
1	Ridge	1.68	44.94	6.70	0.94
0	Linear Regression	1.68	44.94	6.70	0.94
2	Lasso	1.75	45.67	6.76	0.94

```
6                 KNN 1.83  64.33  8.02 0.91
3          ElasticNet 3.92 118.52 10.89 0.84
5            AdaBoost 6.43 151.92 12.33 0.80
```

```
plt.figure(figsize=(6, 6))
sns.barplot(data=results_df, x="R²", y="Model", hue="Model",
palette="viridis", legend=False)
plt.title("ML Models Comparison (Sorted by R²)")
plt.xlabel("R² Score")
plt.ylabel("Model")
```

```
Text(0, 0.5, 'Model')
```