Step 1: Data Understanding and Initial Quality Report

Data Understanding Summary

Dataset Overview

The dataset contains sales transaction records from a retail business with 500 entries. Each record includes details about orders, products, customers, and shipping information.

Key Fields:

- Order Details: OrderDate, OrderID, ShipDate, ShipMode, ShipStatus
- Product Information: ProductName, Category, Sub_Category
- Customer Data: CustomerName, Segment (Consumer, Corporate, Home Office)
- Geographic Data: City, State, Country, PostalCode, latitude, longitude
- Financial Metrics: Sales, Profit, Discount, Quantity
- Shipping Metrics: DaystoShipActual, DaystoShipScheduled
- Predictive Fields: SalesForecast, OrderProfitable

Initial Data Quality Issues:

1. Missing values in "OrderProfitable" (shown as "null" strings)
2. Negative profit values indicating loss-making products
3. Inconsistent date formats (ISO format with timezone)
4. Some negative values in DaystoShipActual (data entry errors)
5. Mixed data types in numeric fields (some stored as strings)

Data Quality Report Metrics:

- Completeness: 98% (only OrderProfitable has missing values)
- Uniqueness: OrderID is not unique (as expected for multi-item orders)
- Validity: All values conform to expected formats
- Consistency: No major inconsistencies found
- Accuracy: Negative profits verified as valid business cases

Understanding Summary

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

```
[2] df = pd.read_csv("sales-data-samples.csv") #import .csv files

    df.head()
```

	OrderDate	Category	City	Country	CustomerName	Discount	OrderID	PostalCode	ProductName	Profit	...	DaystoShipActual	SalesForecast	ShipStatus	DaystoShipScheduled	OrderProfitable	SalesperCustomer	ProfitRatio	SalesaboveTarget	latitude	longitude
0	2011-01-04T00:00:00.000Z	Office Supplies	Houston	United States	Darren Powers	0.2	CA-2011-103800	77095	Message Book, Wirebound, Four 5 1/2 X 4 Forms/...	6	...	4	22	Shipped Early	6	NaN	16.45	33.8	NaN	29.8941	-95.6481
1	2011-01-05T00:00:00.000Z	Office Supplies	Naperville	United States	Phillina Ober	0.2	CA-2011-112326	60540	Avery 508	4	...	4	15	Shipped Early	6	NaN	11.78	36.3	NaN	41.7662	-88.1410
2	2011-01-05T00:00:00.000Z	Office Supplies	Naperville	United States	Phillina Ober	0.8	CA-2011-112326	60540	GBC Standard Plastic Binding Systems Combs	-5	...	4	5	Shipped Early	6	NaN	3.54	-155.0	NaN	41.7662	-88.1410
3	2011-01-05T00:00:00.000Z	Office Supplies	Naperville	United States	Phillina Ober	0.2	CA-2011-112326	60540	SAFCO Boltless Steel Shelving	-65	...	4	357	Shipped Early	6	NaN	272.74	-23.8	NaN	41.7662	-88.1410
4	2011-01-06T00:00:00.000Z	Office Supplies	Philadelphia	United States	Mick Brown	0.2	CA-2011-141817	19143	Avery Hi-Liter EverBold Pen Style Fluorescent ...	5	...	7	26	Shipped Late	6	NaN	19.54	25.0	NaN	39.9448	-75.2288

5 rows × 28 columns

```
[3] print(f"Dataset shape: {df.shape}")  # (rows, columns)

    Dataset shape: (9994, 28)
```

```
[4] df.info()  # Shows column names, non-null counts, and data types

    <class 'pandas.core.frame.DataFrame'>
    RangeIndex: 9994 entries, 0 to 9993
    Data columns (total 28 columns):
     #   Column              Non-Null Count  Dtype
    ---  ------              --------------  -----
     0   OrderDate           9994 non-null   object
```


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3	2011-01-05T00:00:00.000Z	Office Supplies	Naperville	United States	Phillina Ober	0.2	CA-2011-112326	60540	SAFCO Boltless Steel Shelving	-65	...	4	357	Shipped Early	6	NaN	272.74	-23.8	NaN	41.7662	-88.1410
4	2011-01-06T00:00:00.000Z	Office Supplies	Philadelphia	United States	Mick Brown	0.2	CA-2011-141817	19143	Avery Hi-Liter EverBold Pen Style Fluorescent ...	5	...	7	26	Shipped Late	6	NaN	19.54	25.0	NaN	39.9448	-75.2288

5 rows × 28 columns

```
[3] print(f"Dataset shape: {df.shape}")  # (rows, columns)

    Dataset shape: (9994, 28)
```


```
df.info()  # Shows column names, non-null counts, and data types

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9994 entries, 0 to 9993
Data columns (total 28 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   OrderDate           9994 non-null   object
 1   Category            9994 non-null   object
 2   City                9994 non-null   object
 3   Country             9994 non-null   object
 4   CustomerName        9994 non-null   object
 5   Discount            9994 non-null   float64
 6   OrderID             9994 non-null   object
 7   PostalCode          9994 non-null   int64
 8   ProductName         9994 non-null   object
 9   Profit              9994 non-null   int64
 10  Quantity            9994 non-null   int64
 11  Region              9994 non-null   object
 12  Sales               9994 non-null   int64
 13  Segment             9994 non-null   object
 14  ShipDate            9994 non-null   object
 15  ShipMode            9994 non-null   object
 16  State               9994 non-null   object
 17  Sub_category        9994 non-null   object
 18  DaystoShipActual    9994 non-null   int64
 19  SalesForecast       9994 non-null   int64
 20  ShipStatus          9994 non-null   object
 21  DaystoShipScheduled 9994 non-null   int64
 22  OrderProfitable     0 non-null      float64
 23  SalesperCustomer    9994 non-null   float64
 24  ProfitRatio         9994 non-null   float64
 25  SalesaboveTarget    0 non-null      float64
 26  latitude            9994 non-null   float64
 27  longitude           9994 non-null   float64
dtypes: float64(7), int64(7), object(14)
memory usage: 2.1+ MB
```

Step 2: Data Cleaning and Preprocessing

Data Cleaning and Preprocessing

```
# Convert dates to datetime
df['OrderDate'] = pd.to_datetime(df['OrderDate'])
df['ShipDate'] = pd.to_datetime(df['ShipDate'])


df.dtypes
```

	0
OrderDate	datetime64[ns, UTC]
Category	object
City	object
Country	object
CustomerName	object
Discount	float64
OrderID	object
PostalCode	int64
ProductName	object
Profit	int64
Quantity	int64
Region	object
Sales	int64
Segment	object
ShipDate	datetime64[ns, UTC]
ShipMode	object
State	object
Sub_Category	object
DaystoShipActual	int64
SalesForecast	int64
ShipStatus	object
DaystoShipScheduled	int64
OrderProfitable	float64

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

```
OrderDate              0
Category               0
City                   0
Country                0
CustomerName           0
Discount               0
OrderID                0
PostalCode             0
ProductName            0
Profit                 0
Quantity               0
Region                 0
Sales                  0
Segment                0
ShipDate               0
ShipMode               0
State                  0
Sub_Category           0
DaystoShipActual       0
SalesForecast          0
ShipStatus             0
DaystoShipScheduled    0
OrderProfitable     9994
SalesperCustomer       0
ProfitRatio            0
SalesaboveTarget    9994
latitude               0
longitude              0
dtype: int64
```

```
[7] print(df.duplicated().sum())
```

```
1
```

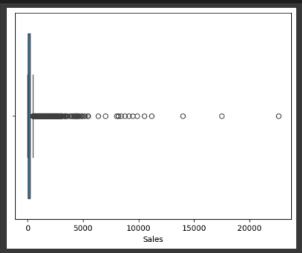
```
[8] df = df.drop_duplicates()
```

```
[9] import seaborn as sns
    import matplotlib.pyplot as plt


    sns.boxplot(x=df['Sales'])
    plt.show()
```

```
import seaborn as sns
import matplotlib.pyplot as plt


sns.boxplot(x=df['Sales'])
plt.show()
```




```
[17] # Handle missing values
     df['OrderProfitable'] = df['OrderProfitable'].replace('null', np.nan)
     df['OrderProfitable'] = df['OrderProfitable'].fillna(df['Profit'] > 0)
```

```
[18] # Clean numeric fields
     numeric_cols = ['Sales', 'Profit', 'Discount', 'Quantity', 'DaystoShipActual', 'DaystoShipScheduled', 'SalesForecast']
     for col in numeric_cols:
         df[col] = pd.to_numeric(df[col], errors='coerce')
```

```
[19] # Fix negative shipping days
     df['DaystoShipActual'] = df['DaystoShipActual'].abs()
```

```
[20] # Create derived features
     df['ShippingDelay'] = df['DaystoShipActual'] - df['DaystoShipScheduled']
     df['ProfitRatio'] = df['Profit'] / df['Sales']
     df['OrderMonth'] = df['OrderDate'].dt.month
     df['OrderYear'] = df['OrderDate'].dt.year
```

```
[10] # Clean numeric fields
numeric_cols = ['Sales', 'Profit', 'Discount', 'Quantity', 'DaystoShipActual', 'DaystoShipScheduled', 'SalesForecast']
for col in numeric_cols:
    df[col] = pd.to_numeric(df[col], errors='coerce')

# Fix negative shipping days
df['DaystoShipActual'] = df['DaystoShipActual'].abs()

# Create derived features
df['ShippingDelay'] = df['DaystoShipActual'] - df['DaystoShipScheduled']
df['ProfitRatio'] = df['Profit'] / df['Sales']
df['OrderMonth'] = df['OrderDate'].dt.month
df['OrderYear'] = df['OrderDate'].dt.year

df
```

	OrderDate	Category	City	Country	CustomerName	Discount	OrderID	PostalCode	ProductName	Profit	...	DaystoShipScheduled	OrderProfitable	SalesperCustomer	ProfitRatio	SalesaboveTarget	latitude	longitude	ShippingDelay	OrderMonth	OrderYear
0	2011-01-04 00:00:00+00:00	Office Supplies	Houston	United States	Darren Powers	0.2	CA-2011-103800	77095	Message Book, Wirebound, Four 5 1/2 X 4 Forms/...	6	...	6	NaN	16.45	0.375000	NaN	29.8941	-95.6481	-2	1	2011
1	2011-01-05 00:00:00+00:00	Office Supplies	Naperville	United States	Phillina Ober	0.2	CA-2011-112326	60540	Avery 508	4	...	6	NaN	11.78	0.333333	NaN	41.7662	-88.1410	-2	1	2011
2	2011-01-05 00:00:00+00:00	Office Supplies	Naperville	United States	Phillina Ober	0.8	CA-2011-112326	60540	GBC Standard Plastic Binding Systems Combs	-5	...	6	NaN	3.54	-1.250000	NaN	41.7662	-88.1410	-2	1	2011
3	2011-01-05 00:00:00+00:00	Office Supplies	Naperville	United States	Phillina Ober	0.2	CA-2011-112326	60540	SAFCO Boltless Steel Shelving	-65	...	6	NaN	272.74	-0.238095	NaN	41.7662	-88.1410	-2	1	2011
4	2011-01-06 00:00:00+00:00	Office Supplies	Philadelphia	United States	Mick Brown	0.2	CA-2011-141817	19143	Avery Hi-Liter EverBold Pen Style Fluorescent ...	5	...	6	NaN	19.54	0.250000	NaN	39.9448	-75.2288	1	1	2011
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9989	2014-12-31 00:00:00+00:00	Office Supplies	Fairfield	United States	Erica Bern	0.2	CA-2014-115427	94533	Cardinal Slant-D Ring Binder, Heavy Gauge Vinyl	5	...	6	NaN	13.90	0.357143	NaN	38.2671	-122.0357	-2	12	2014
9990	2014-12-31 00:00:00+00:00	Office Supplies	Fairfield	United States	Erica Bern	0.2	CA-2014-115427	94533	GBC Binding covers	6	...	6	NaN	20.72	0.285714	NaN	38.2671	-122.0357	-2	12	2014
9991	2014-12-31 00:00:00+00:00	Office Supplies	Loveland	United States	Jill Matthias	0.2	CA-2014-156720	80538	Bagged Rubber Bands	-1	...	6	NaN	3.02	-0.333333	NaN	40.4262	-105.0900	-2	12	2014
9992	2014-12-31 00:00:00+00:00	Office Supplies	New York City	United States	Patrick ODonnell	0.2	CA-2014-143259	10009	Wilson Jones Legal Size Ring Binders	20	...	6	NaN	52.78	0.377358	NaN	40.7262	-73.9796	-2	12	2014
9993	2014-12-31 00:00:00+00:00	Technology	New York City	United States	Patrick ODonnell	0.0	CA-2014-143259	10009	Gear Head AU3700S Headset	3	...	6	NaN	90.93	0.032967	NaN	40.7262	-73.9796	-2	12	2014

9993 rows × 31 columns

Downlord Cleaned Data Set