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Enhanced Inventory Management

ECE 143 - Group 10

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About the dataset - Spirits LLC

- **A liquor retailer with 79 stores across 67 cities in England.**
- **Inventory data as of 1st January and as of 31st December.**
- **Sales data for the month of January.**
- **Purchase data from 1st January to 31st December.**
- **116 vendors and their invoice data over the year.**

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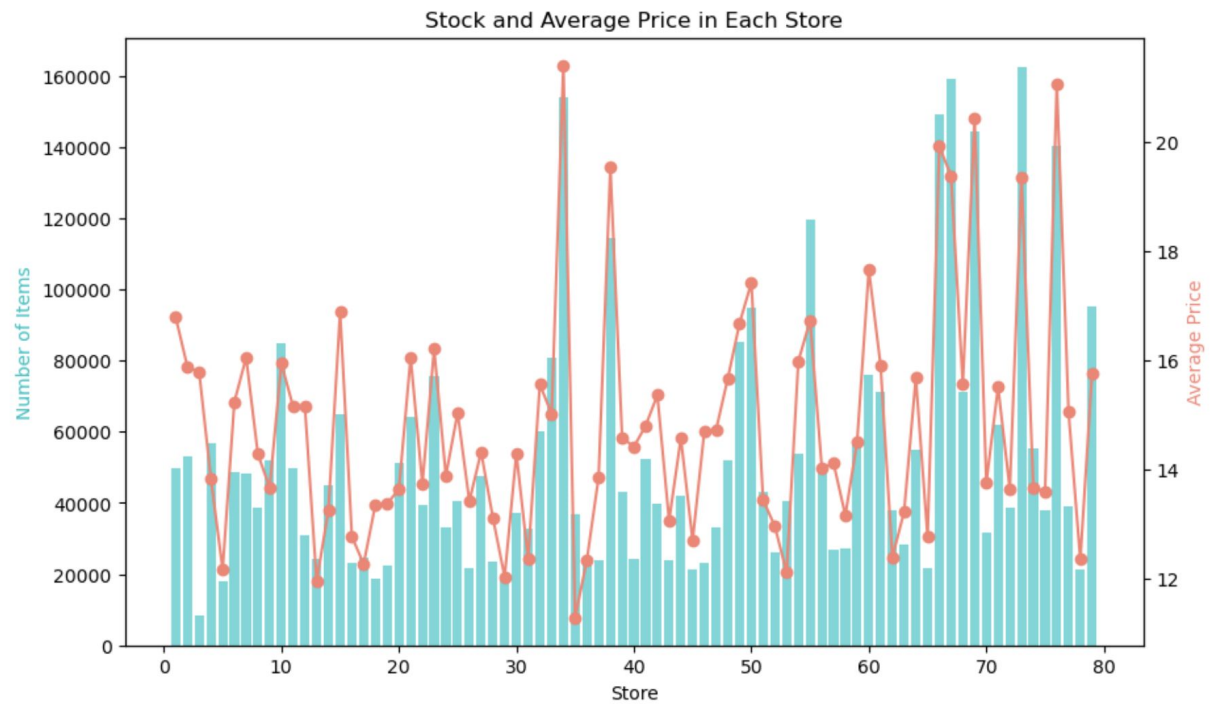
Methodology

Process of Data Extraction and Analysis

- Cleaning up data and creating coherent data frames from the several csv files.
- Proposing hypotheses for correlations and checking if the data supported them.
- Understanding the economic factors involved in efficient inventory management.
- Understanding and analyzing the data, and plotting any correlations.

Primary Insights

Stock Quantity and Average Price



Observations from Stock Data as of 1st January

- Stores do not hold a uniform quantity of stock.
- Average price per bottle also differs from store to store.
- Stores that held more stock, also had a higher average price per bottle.

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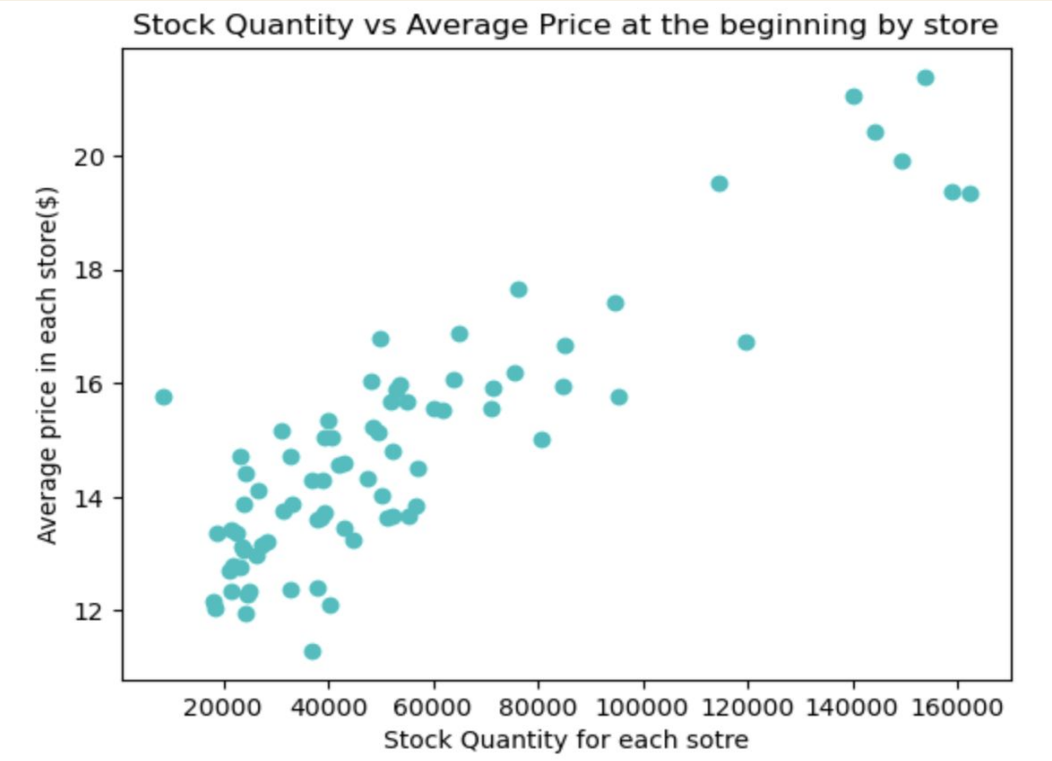
Observed Correlation



88% correlation found

- The stock quantity held in each store, is correlated with the average price per bottle held.
- Stores holding higher quantities might cater to wider markets.
- The larger stores might be more popular with the wealthier drinkers.

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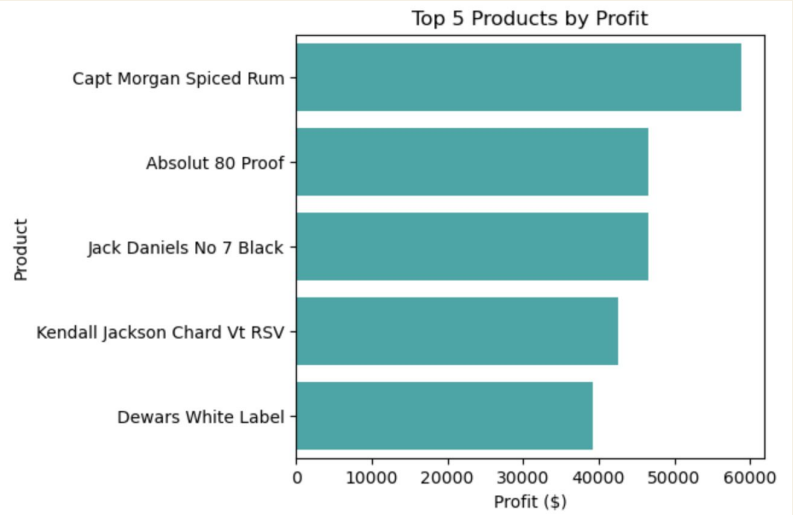
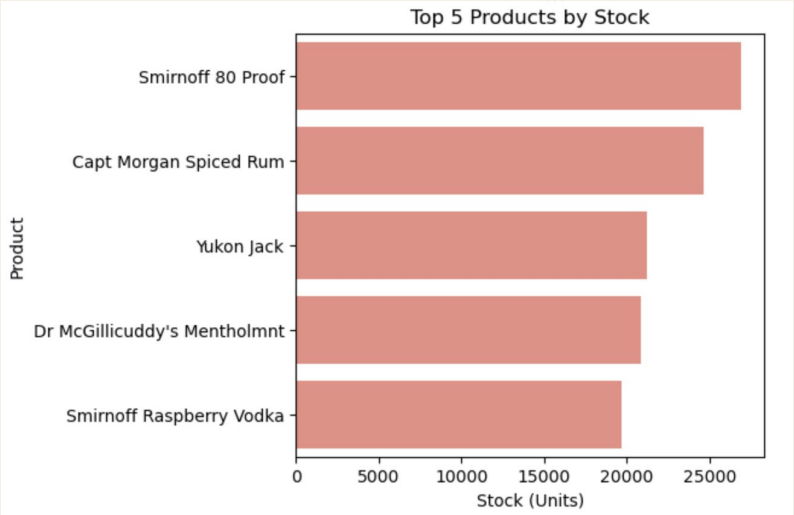
Discrepancy between held stock and profitable stock





- Only 1 of the top 5 most profitable products was held in the top 5 quantities
- This highlights the need to better manage inventory to optimize profits.
  - The profitable products may be running out of stock.
  - The non-profitable/stagnant products may be held in unnecessary quantities.

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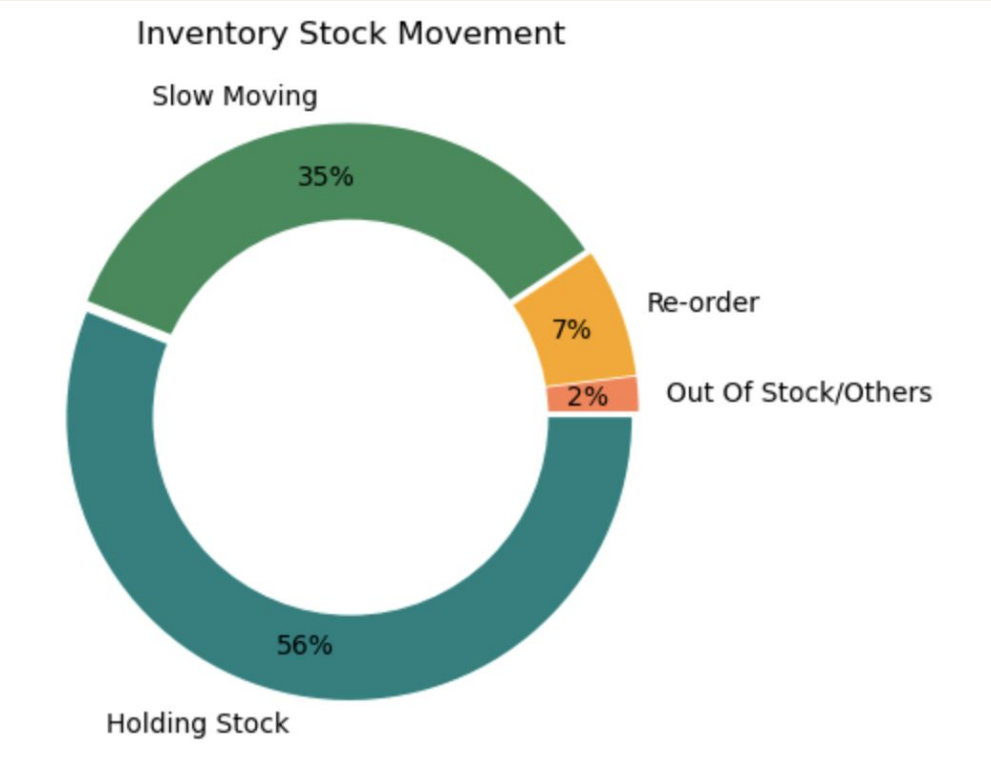
Categorization of Products held in stock



Stock Movement Analysis

- Analysed stock movement data from inventory data and purchase data.
- Observed that of the products held:
  - 56% of them are ~75% stagnant.
  - 35% of them are slow moving, or are ~30-75% stagnant.
  - 7% are nearing re-order levels with < 30% stock stagnated.
  - 2% have run out of stock.

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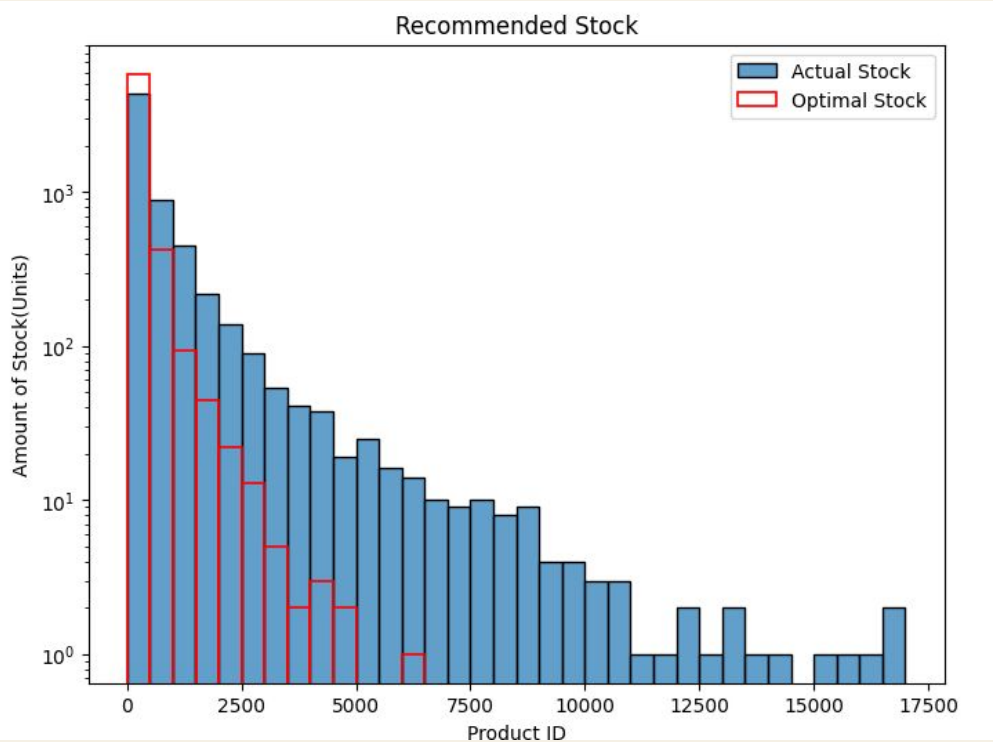
Economic Order Quantity Analysis



- Used sales, purchase and inventory data to perform EOQ analysis.
- Limited sales data only covered a subset of all products.
- For the products covered, we observed:
  - Select few products were held in insufficient amount.
  - Majority of products were held in excess.

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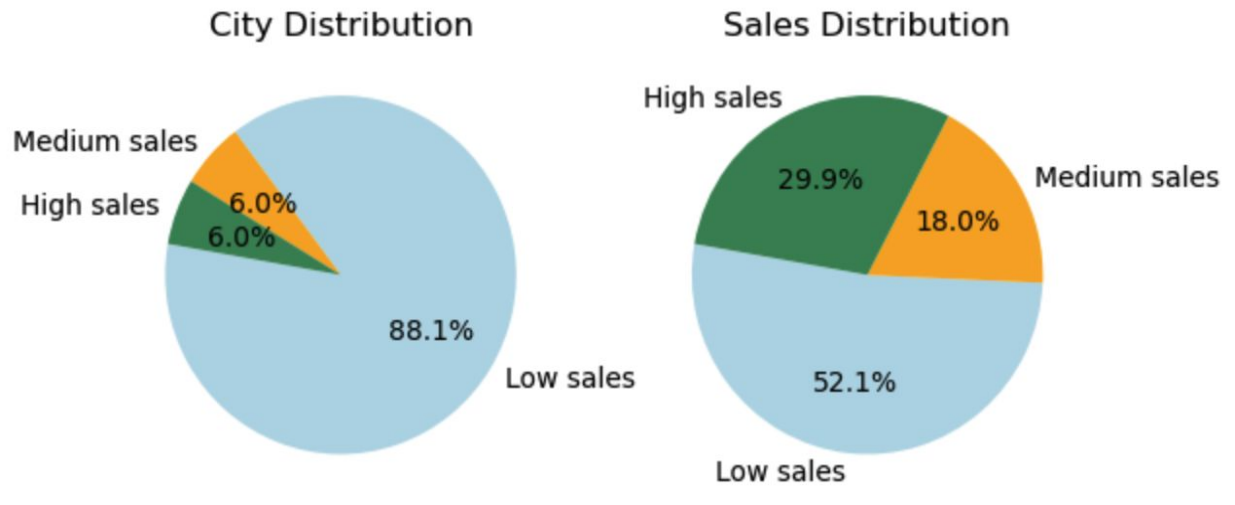
Sales Insights

Categorization of Cities by Sales Volume



6% of the cities contributed to 29.9% of the total sales.

5x its weight factor

6% of the cities contributed to 18% of the total sales.

3x its weight factor

88% of the cities contributed to 52% of the total sales.

0.6x its weight factor

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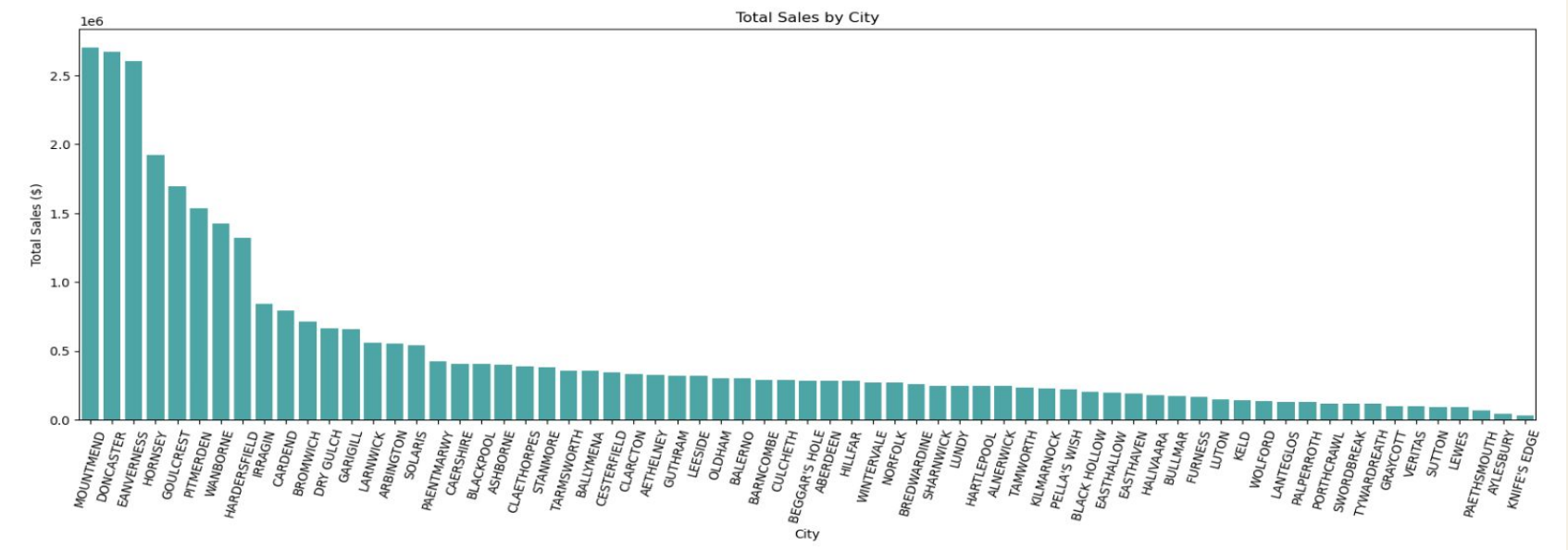
Sales Distribution across Cities



- City populations and drinking cultures are major reasons for the uneven distribution.
- https://www.teamdoncaster.org.uk/Documents/DocumentView/Stream/Media/Tenant2/Data%20Observatory/Drugs%20Alcohol%20HNA.pdf

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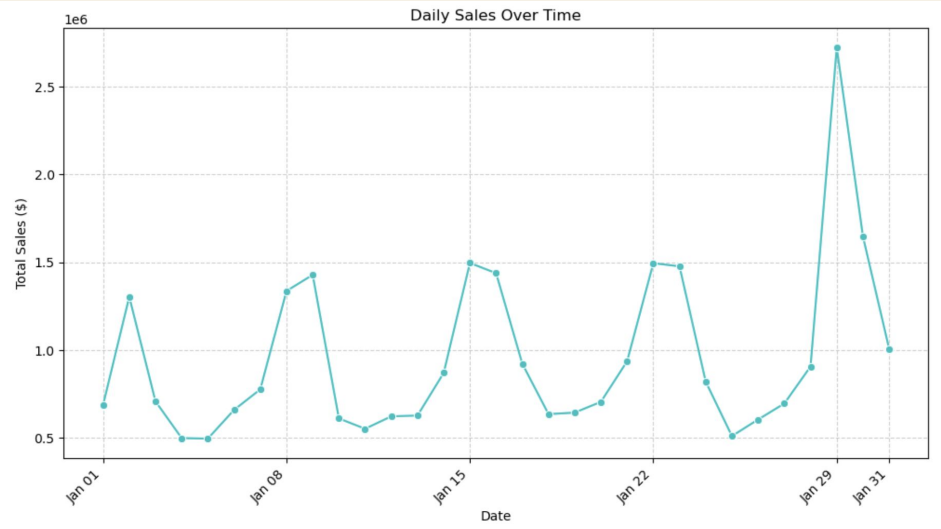
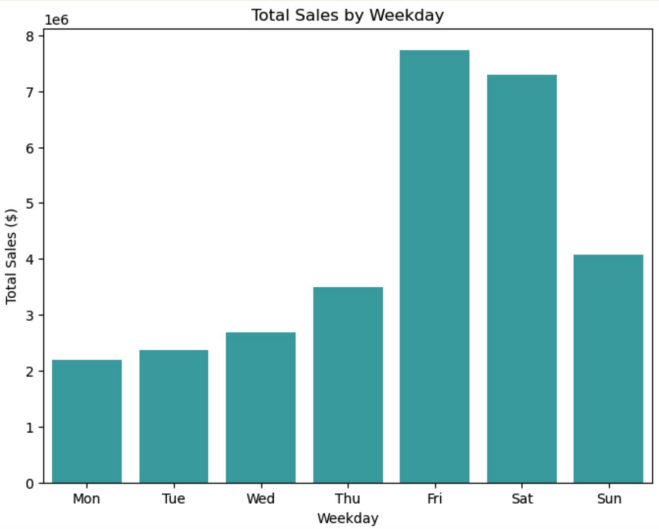
Sales Pattern





- Over the month of January, sales followed a very regular pattern.
- The last Friday of the month had higher sales, possibly due to salary credits.
- This pattern repeated on a weekly basis.
  - Fridays and Saturdays had significantly higher alcohol sales.
  - Mondays had the least alcohol sales (no surprises there).

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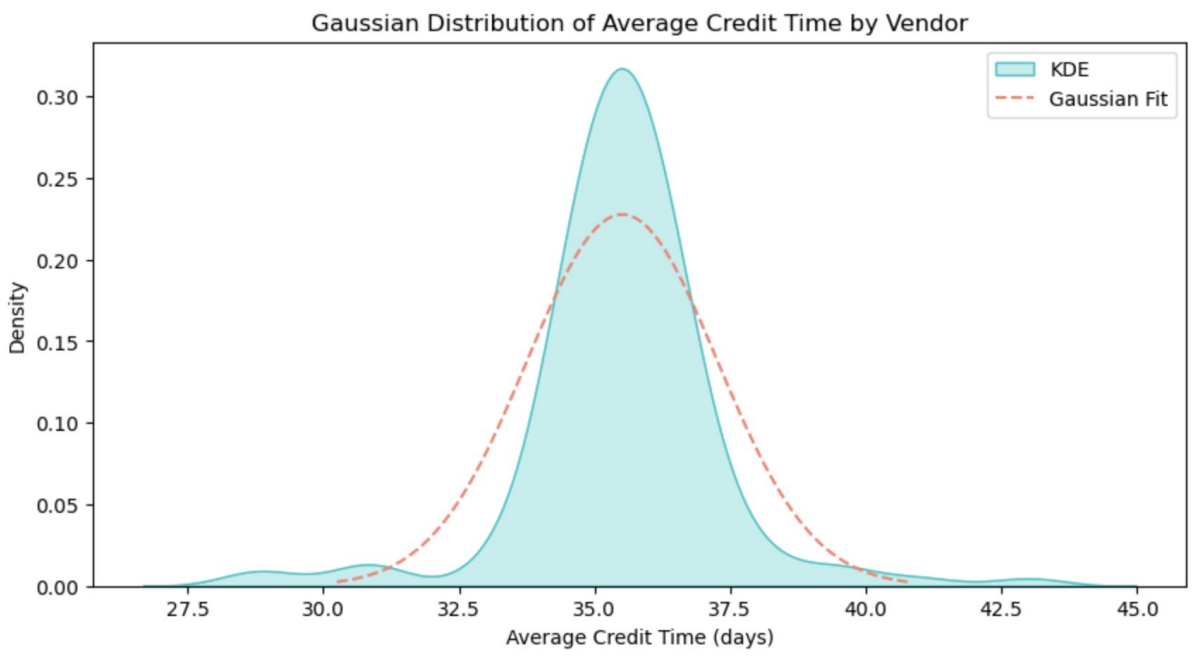
Purchase Insights

Trade Credit Time for the Vendors



Most vendors seem to extend around **36 days** of trade credit.

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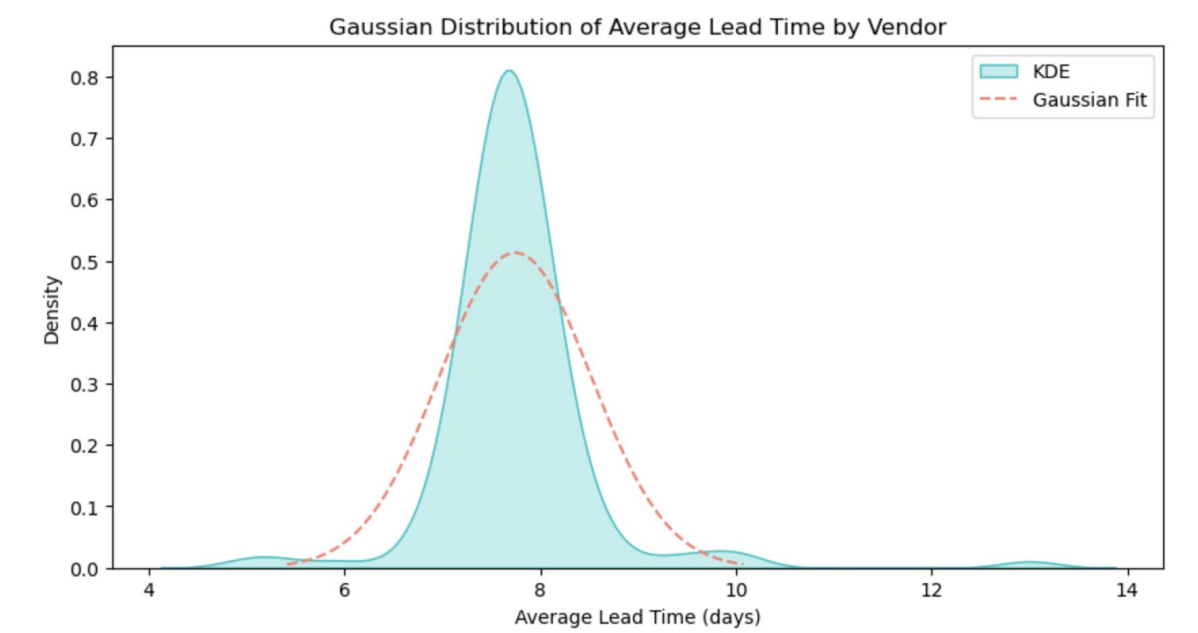
Delivery Lead Time for the Vendors



Most vendors seem to take about **7-8 days** to deliver the products after a purchase order was placed.

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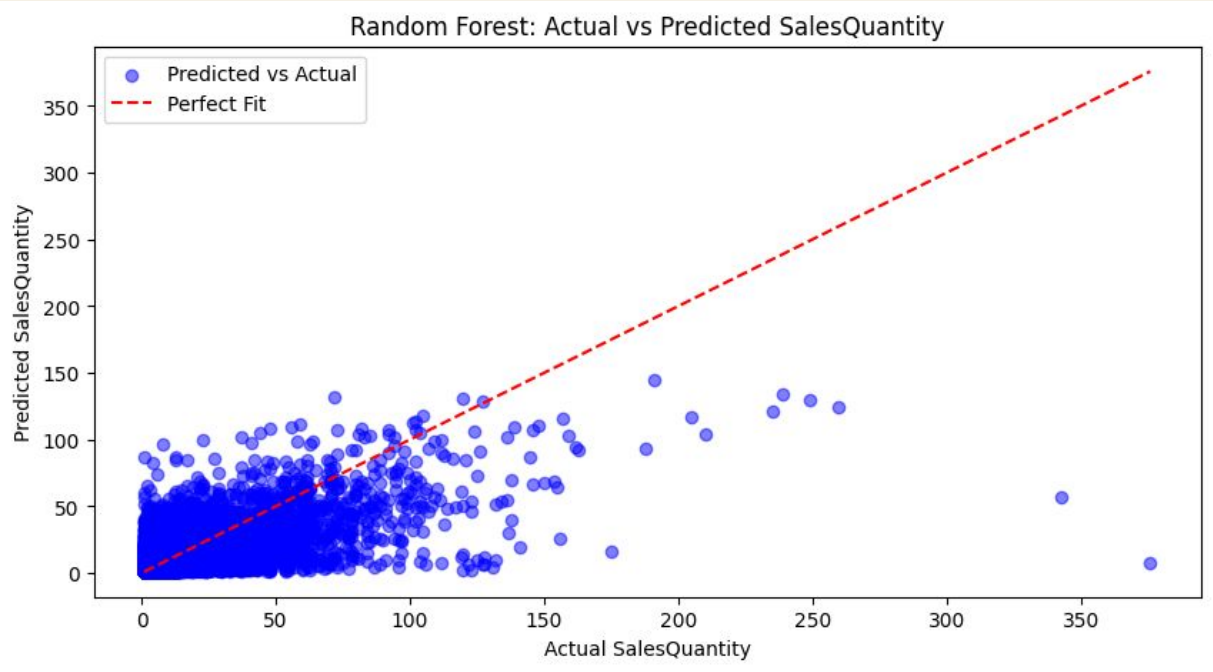
Demand Forecasting

Experiments with various models

Model	MAE	MSE
Linear Regression	3.41	54.56
Ridge Regression	3.41	54.56
Random Forest	2.56	29.25
KNN	2.7	33.86

Demand Forecasting

Observations



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