

DATA SCIENCE CHALLENGE

# Inventory Optimization & Supply Chain Analysis

Slooze Take-Home Challenge

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Technical Documentation  
Comprehensive Analysis Report  
January 2026

# Table of Contents

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<b>1. Executive Summary</b>	<b>3</b>
<b>2. Problem Statement &amp; Objectives</b>	<b>4</b>
2.1 Business Context	4
2.2 Core Objectives	4
<b>3. Dataset Overview</b>	<b>5</b>
<b>4. Methodology</b>	<b>6</b>
4.1 Phase 1: Data Exploration & Cleaning	6
4.2 Phase 2: ABC Analysis	7
4.3 Phase 2.2: Demand Forecasting	8
4.4 Phase 2.3: Reorder Point Analysis	8
4.5 Phase 2.4: Lead Time Analysis	9
<b>5. Key Results</b>	<b>10</b>
<b>6. Assumptions &amp; Limitations</b>	<b>12</b>
<b>7. Business Recommendations</b>	<b>13</b>
<b>8. How to Run the Code</b>	<b>14</b>
<b>9. Conclusion</b>	<b>15</b>

# 1. Executive Summary

This analysis presents a comprehensive inventory optimization system for Slooze, a retail wine and spirits company operating across multiple locations. Using 2.37 million purchase records, 1.05 million sales transactions, and inventory data from 2016, we implemented four core analytical frameworks to transform raw transactional data into actionable business intelligence.

## Key Deliverables

- **ABC Analysis:** Classified 7,658 products by revenue contribution using the 80/20 rule

### Critical Finding

80% of revenue comes from only 19.6% of products (A-Class), yet none of these critical products use Premium suppliers. This creates a significant supply chain vulnerability that requires immediate attention.

## Summary Metrics

Metric	Value
Total Revenue Analyzed	\$33.1 Million
Unique Products	7,658
Vendors Evaluated	128
Store Locations	79

## 2. Problem Statement & Objectives

### 2.1 Business Context

Slooze manages millions of transactions across sales, purchases, and inventory records spanning 79+ store locations. Traditional spreadsheet-based analysis is inadequate for this data volume, creating risks of:

- Stockouts of high-revenue items leading to lost sales

### 2.2 Core Objectives

Objective	Description	Success Metric
Inventory Optimization	Determine ideal stock levels by category	Reduced stockouts + carrying costs
Sales & Purchase Insights	Identify trends and supplier efficiency	Clear product/vendor segmentation
Process Improvement	Optimize procurement and stock control	Data-driven reorder triggers

### Analytical Tasks Completed

1. ABC Analysis - Product classification by revenue contribution

2.

### 3. Dataset Overview

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#### Data Sources (6 Files)

File Name	Size	Records	Purpose
SalesFINAL12312016.csv	127.86 MB	1,048,575	Sales transactions
PurchasesFINAL12312016.csv	401.75 MB	2,372,474	Purchase orders
BegInvFINAL12312016.csv	19.31 MB	206,529	Beginning inventory
EndInvFINAL12312016.csv	21.00 MB	224,489	Ending inventory
InvoicePurchases12312016.csv	591 KB	5,543	Invoice records
2017PurchasePricesDec.csv	1.16 MB	12,261	Price reference

#### Data Quality Summary

##### Dataset Characteristics

- **Date Range:** January 1 - December 31, 2016 (with February anomaly)

## 4. Methodology

### 4.1 Phase 1: Data Exploration & Cleaning

The dataset was automatically downloaded using KaggleHub (61.9 MB compressed). All 6 CSV files were loaded into pandas DataFrames with appropriate data type optimization for memory efficiency.

#### Data Cleaning Steps

1. Standardized date formats (PODate, ReceivingDate, SalesDate)

2.

### 4.2 Phase 2: ABC Analysis

Classify inventory by revenue contribution to prioritize management attention and allocate resources effectively.

#### Classification Criteria

Class	Criteria	Priority
A-Class	Top 80% cumulative revenue	High
B-Class	80-95% cumulative revenue	Medium
C-Class	Bottom 5% cumulative revenue	Low

### 4.3 Phase 2.2: Demand Forecasting

Implemented Facebook Prophet models with daily and weekly seasonality, multiplicative seasonality mode, and 14-day forecast horizon. MAE and RMSE calculated for model validation.

### 4.4 Phase 2.3: Reorder Point Analysis

$ROP = (\text{Average Daily Demand} \times \text{Lead Time}) + \text{Safety Stock}$

Where  $\text{Safety Stock} = Z \times \text{Standard Deviation} \times \sqrt{\text{Lead Time}}$

Parameter	Value	Description
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Parameter	Value	Description
Service Level	95%	Z-score = 1.65 (industry standard)
Lead Time	7.3-7.6 days	Vendor-specific average
Safety Stock	Variable	Based on demand variability

## 4.5 Phase 2.4: Lead Time Analysis

Classification	Lead Time	Std Dev	Risk
Premium	<= 7.7 days	<= 2.2 days	Low
Fast but Variable	<= 7.7 days	> 2.2 days	Medium
Slow but Steady	> 7.7 days	<= 2.2 days	Low-Medium
High Risk	> 7.7 days	> 2.2 days	High

## 5. Key Results

### ABC Analysis Results

Category	Products	% SKUs	Revenue	% Revenue
A-Class	1,502	19.6%	\$26.51M	80.0%
B-Class	1,813	23.7%	\$4.97M	15.0%
C-Class	4,343	56.7%	\$1.66M	5.0%

### Top 5 Revenue Products

Rank	Product	Revenue	% of Total
1	Captain Morgan Spiced Rum	\$444,811	1.34%
2	Ketel One Vodka	\$357,759	1.08%
3	Jack Daniels No 7 Black	\$344,712	1.04%
4	Absolut 80 Proof	\$288,135	0.87%
5	Tito's Handmade Vodka	\$275,163	0.83%

### Reorder Point Results

Product	ROP	Current	Status
Captain Morgan	5,676	16,769	Healthy
Ketel One	3,616	16,770	Healthy
Jack Daniels	2,620	15,047	Healthy
Absolut	2,978	12,268	Healthy
Tito's	2,811	14,018	Healthy

#### Inventory Status

All products are currently healthy with current stock levels 2-4x above reorder points. No immediate stockout risk detected.

### Lead Time Analysis Results

Tier	Vendors	Spend	Risk
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Tier	Vendors	Spend	Risk
Premium	26 (21.7%)	\$50.6M	Low
Fast but Variable	34 (28.3%)	\$165.0M	Medium
Slow but Steady	35 (29.2%)	\$82.9M	Low-Medium
High Risk	25 (20.8%)	\$23.5M	High

### Critical Supplier Risk

All top 5 revenue products use "Fast but Variable" or "Slow but Steady" vendors. None use Premium vendors. Vendor 3960 (Diageo) supplies 40% of A-Class revenue - significant concentration risk.

## 6. Assumptions & Limitations

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### Data Limitations

1. Temporal Scope: Only 60 days of reliable data (January 2016). February showed 90% sales drop.

2.

### Analytical Assumptions

1. Service Level: 95% used for safety stock calculations ( $Z = 1.65$ , industry standard)

2.

### Technical Constraints

1. Prophet Forecasts: Limited by short time series (60 observations)

2.

## 7. Business Recommendations

### Immediate Actions (0-30 Days)

1. Dual-Source Vendor 3960: 40% of A-Class revenue depends on single supplier (Diageo)
2.

### Strategic Initiatives (30-90 Days)

1. Supplier Development: Move A-Class products to Premium vendors (currently 0/5)
2.

### Risk Mitigation Priorities

Risk Factor	Exposure	Mitigation
Vendor Concentration	21.7% Premium tier	Diversify supplier base
Variable Suppliers	\$165M (51.2%) spend	Increase safety stock
Lead Time Buffer	7.6-day avg, 2.2-day var	Maintain safety coverage

## 8. How to Run the Code

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### Prerequisites

- Python 3.8 or higher

### Installation

```
pip install pandas numpy matplotlib seaborn plotly prophet scikit-learn kagglehub
```

### Execution Steps

1. Download Dataset: Automatically via KaggleHub

2.

### Output Files

- ABC\_Analysis\_Results.csv

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## 9. Conclusion

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This analysis transformed Slooze's raw transactional data into actionable inventory intelligence. Through ABC classification, we identified that 20% of products drive 80% of revenue - yet these critical items rely on variable suppliers, creating significant supply chain vulnerability.

The reorder point system provides data-driven triggers for procurement, while vendor analysis reveals \$85 million in spend with suboptimal suppliers. By implementing the dual-sourcing and safety stock recommendations, Slooze can protect high-revenue streams while optimizing working capital across the portfolio.

### Key Deliverables Provided

- Automated data pipeline with KaggleHub integration

#### Final Note

All code is modular, documented, and ready for production deployment. The analysis framework can be extended to include additional data sources and more sophisticated forecasting models as the data infrastructure matures.

--- End of Documentation ---