

AI POWERED INVENTORY MANAGEMENT SERVICE FOR SMALL/MEDIUM BUSSINESSESS BY S AJAY

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For FeyNN Labs

Aim is to propose an AI-powered inventory management service designed to optimize supply chains and streamline inventory operations for small-scale and medium businesses. Leveraging machine learning algorithms, it offers accurate demand forecasting, efficient stock replenishment strategies, and real-time insights, enabling businesses to minimize stockouts, reduce excess inventory costs, and enhance overall supply chain efficiency.

1. Problem statement

Small-scale and medium businesses struggle with inefficient inventory management, leading to stockouts, excess inventory, increased costs, and compromised customer satisfaction. Traditional approaches lack accuracy and agility, hindering optimal supply chain optimization. Manual processes and limited visibility into inventory levels result in poor decision-making. Resource constraints and a lack of expertise in machine learning hinder access to advanced inventory management solutions. A cost-effective, user-friendly AI-powered service is needed to accurately forecast demand, optimize stock levels, and provide real-time insights. Businesses require scalable and tailored solutions to reduce costs, enhance supply chain efficiency, and deliver exceptional customer experiences.

2. Market/Customer/Business Need assessment

- **Market Size and Potential:** A significant market exists, encompassing industries such as retail, e-commerce, manufacturing, and distribution, with small-scale and medium businesses forming a substantial customer base.
- **Pain Points and Challenges:** Businesses face issues such as inaccurate demand forecasting, stockouts, excess inventory, increased costs, and compromised customer satisfaction due to manual processes, limited visibility, and resource constraints.
- **Competitive Landscape:** Current solutions are often expensive and complex, targeting larger enterprises, leaving a gap for affordable, user-friendly options tailored to the specific needs of small-scale and medium businesses.
- **Business Benefits:** Optimal inventory levels, reduced costs, improved cash flow, and enhanced supply chain efficiency are sought-after outcomes. Businesses require accurate demand forecasting, real-time insights, seamless integration, and actionable recommendations.
- **Market Demand and Readiness:** Strong market demand exists for an AI-powered inventory management service, supported by increasing adoption of AI and machine learning and growing recognition of data-driven decision-making.
- **Competitive Advantage:** Offering a cost-effective, user-friendly solution tailored for small-scale and medium businesses can create a competitive advantage over existing solutions.
- **Customer Acquisition and Retention:** Customer acquisition and retention strategies are crucial, highlighting the importance of showcasing benefits, ease of use, and return on investment, alongside building strong relationships and providing excellent customer support.

The AI-powered inventory management service fulfills a clear market/customer/business need, providing value through operational efficiency, cost savings, and improved customer satisfaction for small-scale and medium businesses.

3. Target Specifications and Characterization

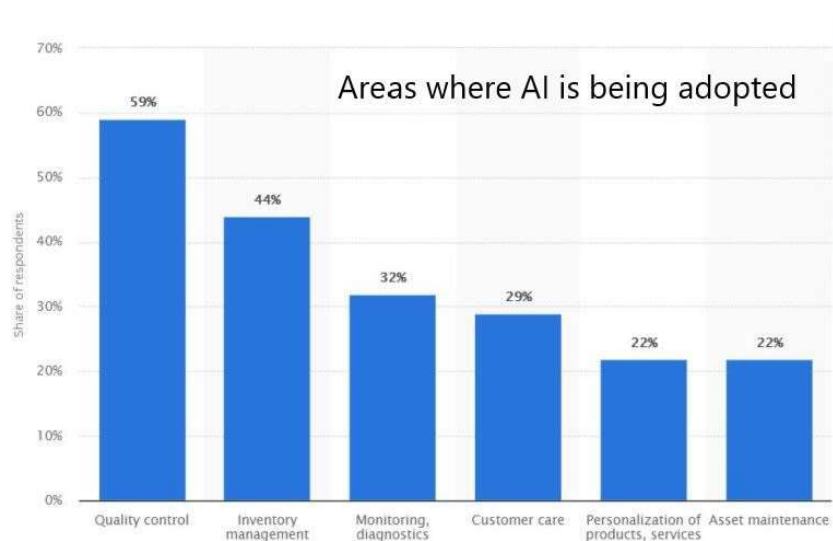
The target customers for this AI-powered inventory management service are small-scale and medium businesses in retail, e-commerce, manufacturing, and distribution industries. These customers have moderate inventory volumes, face resource constraints, and seek affordable solutions. They manage diverse product ranges, require accurate demand forecasting, and aim to optimize inventory levels. Technologically proficient and data-driven decision-makers, they value seamless integration, real-time insights, and user-friendly interfaces. By addressing their specific needs, the service helps businesses improve operational efficiency, reduce costs, and enhance supply chain management.

4. External Search

Information sources were from basic Google searches, write ups in various industrial blogs which deal with issues in small- medium business. Implementation of AI in inventory management and other applications of it related to industrial space. Such as,

- AI in Inventory management

Inventory management issues in small businesses



5. Bench marking alternate products

Many popular Inventory management services such as Zoho, Fishbowl inventory exists, though their mode of operation is undisclosed and they utilize cloud based large storage structure for providing services for even larger companies and Industries. Its cloud-based nature, integrations, and customization options make it a flexible solution for businesses of various sizes and industries. But our aim to use simple ML/DL algorithms for small/medium scale purposes.

6. Applicable Patents

There are few patents registered in AI-powered inventory management service, few of them include Unmanned store operation service, AI- and ML-powered hospital inventory management and forecasting software application.

Read more at:

<https://health.economictimes.indiatimes.com/news/hospitals/medikabazaar-patents-vizi-ai/ml-based-inventory-management/83570461>

7. Applicable Regulations

- **Data Privacy and Protection:** Regulations such as the General Data Protection Regulation (GDPR) in the European Union and the California Consumer Privacy Act (CCPA) in the United States govern the collection, storage, and processing of personal data. Ensure compliance with these regulations when handling customer data and implement appropriate data protection measures.
- **Security and Cybersecurity:** Implement measures to protect the integrity and security of data and systems, considering relevant cybersecurity regulations and standards. These may include industry-specific requirements and guidelines.
- **Intellectual Property:** Respect intellectual property rights and ensure that AI-powered inventory management service does not infringe upon existing patents, copyrights, or trademarks. Conduct proper due diligence and consult with legal experts to avoid any potential infringements.
- **Consumer Protection:** These regulations aim to safeguard consumer rights, prevent unfair practices, and ensure transparent and accurate communication with customers.
- **E-commerce and Online Transactions:** e-commerce or online transactions, comply with applicable regulations related to electronic signatures, online payments, consumer rights in online transactions, and electronic commerce laws.
- **Environmental Regulations:** It is important to comply with environmental regulations related to waste management, hazardous material handling, and sustainable practices.

Regulations are subject to change and may differ depending on the countries or regions of operation.

8. Applicable Constraints

Not many space constraints as it is a digitally oriented service. Expertise and budget is standard and don't think there exists any necessary constraint.

9. Business Model

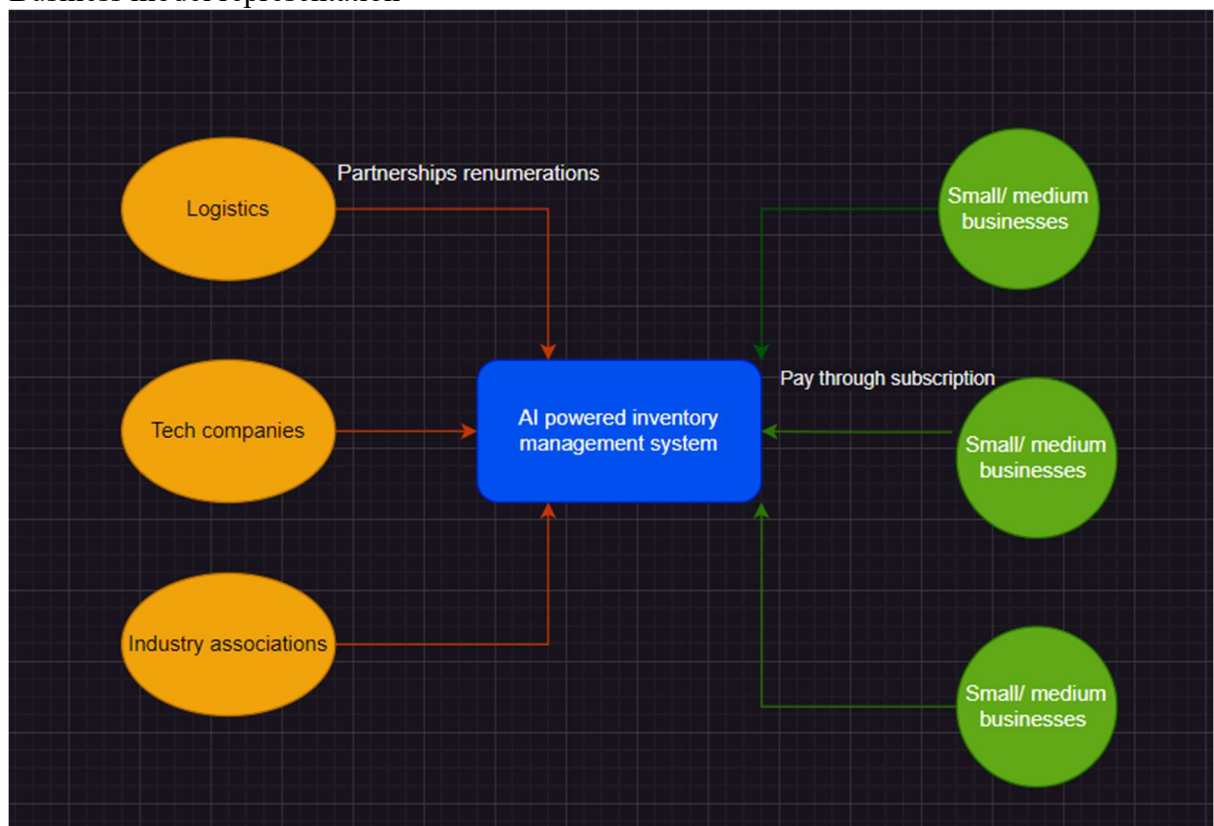
- Monetization method-

It can be a subscription-based model where businesses pay a recurring fee for accessing and utilizing the AI-Powered Inventory Management platform. Or we can consider a transaction-based model, where businesses pay per usage or based on the value derived from inventory optimization.

- Partnerships-

Revenue can be generated using some key partnerships with Logistic companies, Technology providers, warehouses, local transportation. Recommendation of software technologies or hardware can generate revenue in the form of commission as well.

Business model representation



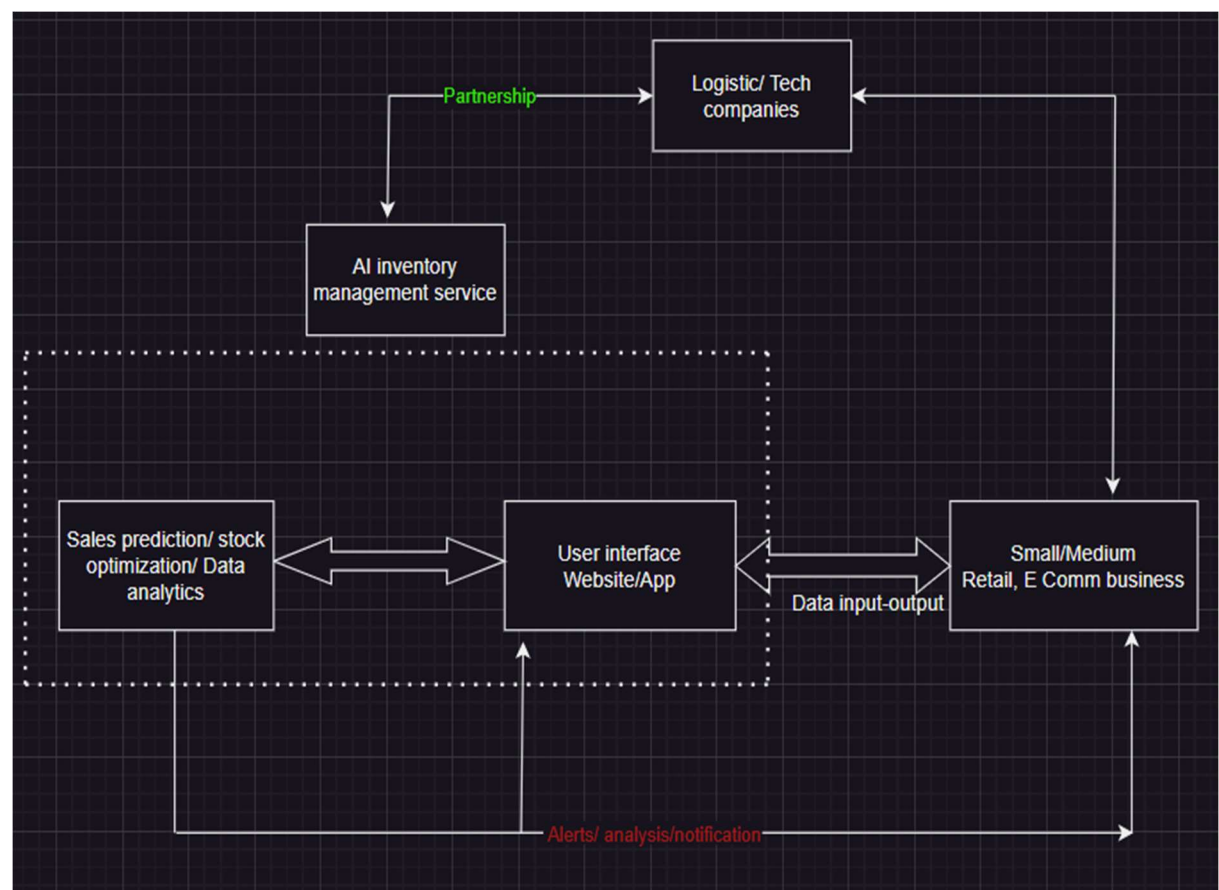
10. Concept generation

Small businesses often face challenges in managing their inventory efficiently due to limited resources and expertise. AI-powered inventory management systems can analyze historical data, current trends, and demand patterns to optimize inventory levels. This helps in reducing stockouts and overstocking, ensuring that the right products are available at the right time, and minimizing holding costs. It occurred to me that we can provide services to these businesses while also gaining substantial income.

11. Concept development

Concept development involves inventory management using AI, for that build a demand forecasting model that predicts future product demand based on the historical data and the extracted features. There are various machine learning algorithms suitable for demand forecasting, such as linear regression, decision trees, random forests, gradient boosting, or even more advanced methods like recurrent neural networks (RNNs) or transformer-based models. Select and train a model that best fits the characteristics of the data and business requirements.

12. Final product prototype

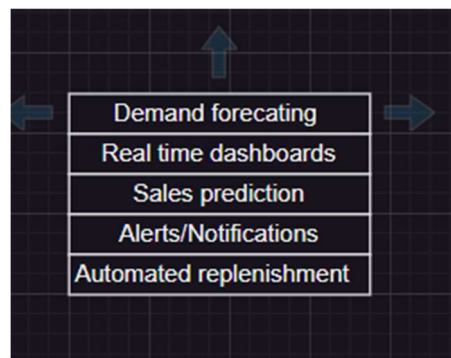


- AI-based inventory management service is a solution that harnesses the power of artificial intelligence and machine learning to optimize inventory operations for small-scale and medium businesses.
- With a user-friendly dashboard, advanced analytics, and predictive capabilities, our service enables businesses to gain real-time visibility into inventory levels, accurately forecast demand, and optimize inventory to reduce costs and minimize stockouts.
- User interface forms the platform for interaction, can be deployed in app or website form.
- Revenue generation is through subscription for services and commissions through partnerships.

13. Product details

13.1. How it works

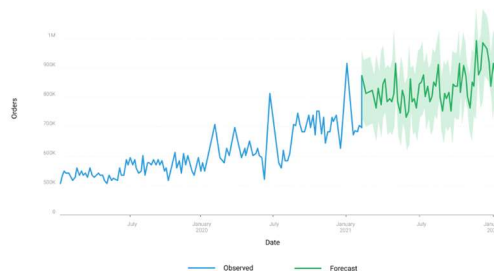
Based on user data, comprehensive analysis is done. Possible features are-



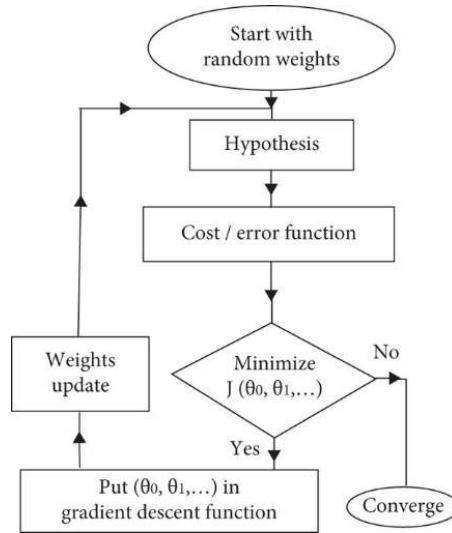
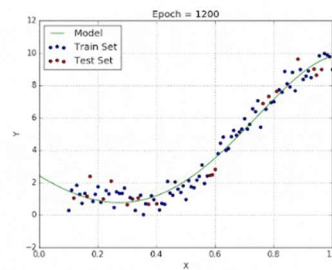
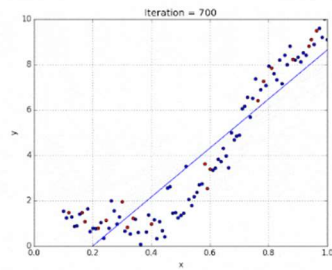
13.2. Algorithms

- Possible algorithms for Demand forecasting-

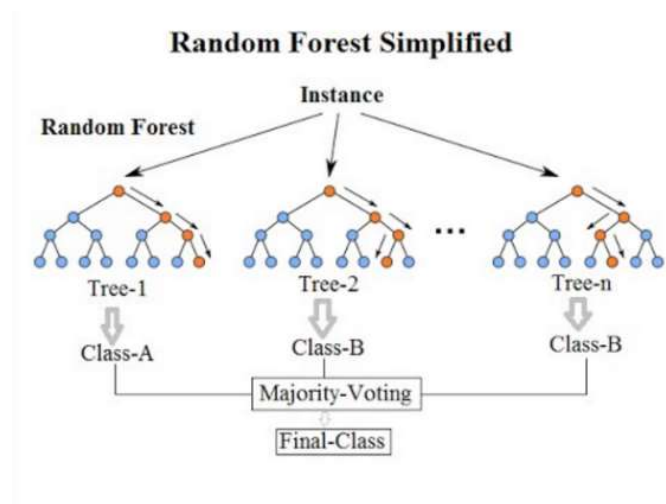
Time series models like Arima, Sarima.



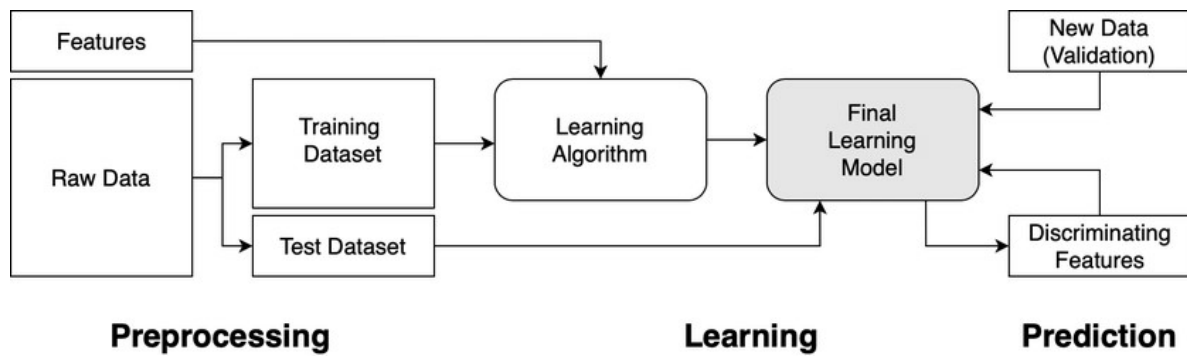
➤ **For Sales prediction – Linear and polynomial regression**



➤ **Predictive Modelling-** The classification module predicts the SKU which needs to be kept in the inventory using classification algorithms like random forest

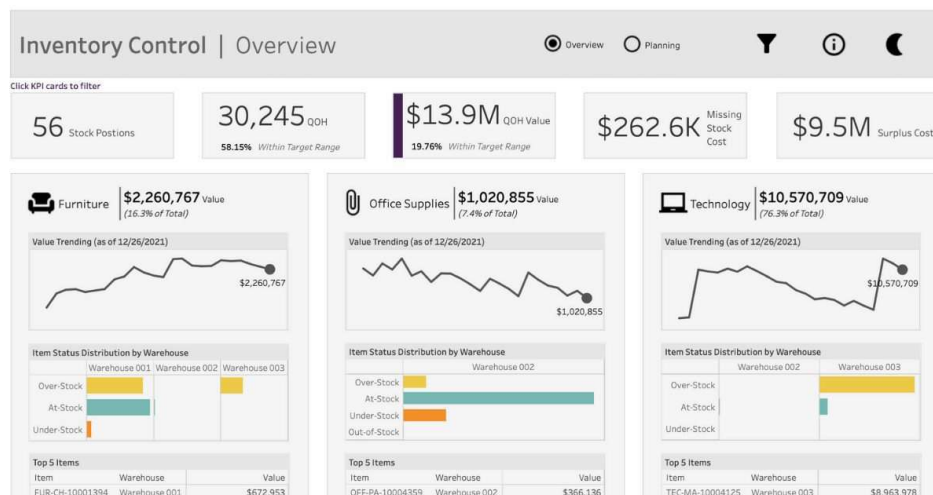


➤ ML model creation flowchart



➤ For visualization of dashboards

Real time analysis of data using tableau software can be done.



13.3.Data sources

- Sales and Transaction Data
- Inventory Data
- Supply Chain Data
- External Market Data
- Customer Data

13.4. Team required to develop

- ML engineers
- Data scientists/analysts
- Web/App developers
- Marketing/ sales person

14. Code Implementation

14.1. Example data set

```
3]: # Gist of the dataset
sales_data.head()
```

```
3]:
```

	Order	File_Type	SKU_number	SoldFlag	SoldCount	MarketingType	ReleaseNumber	New_Release_Flag	StrengthFactor	PriceReg	ReleaseYear	ItemCount	LowUserPri
0	2	Historical	1737127	0.0	0.0	D	15	1	682743.0	44.99	2015	8	28.97
1	3	Historical	3255963	0.0	0.0	D	7	1	1016014.0	24.81	2005	39	0.00
2	4	Historical	612701	0.0	0.0	D	0	0	340464.0	46.00	2013	34	30.19
3	6	Historical	115883	1.0	1.0	D	4	1	334011.0	100.00	2006	20	133.93
4	7	Historical	863939	1.0	1.0	D	2	1	1287938.0	121.95	2010	28	4.00

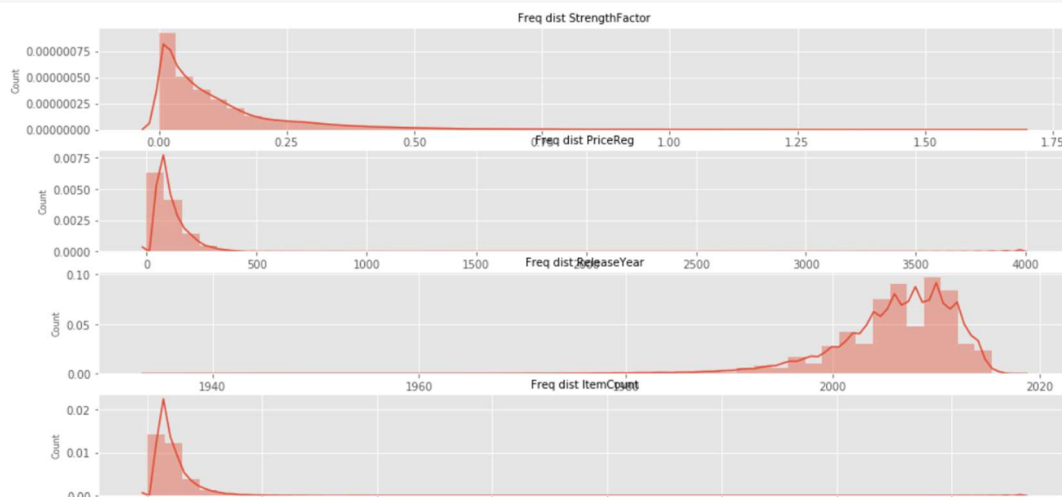
14.2. Few visualizations and EDA (For outlier detection)

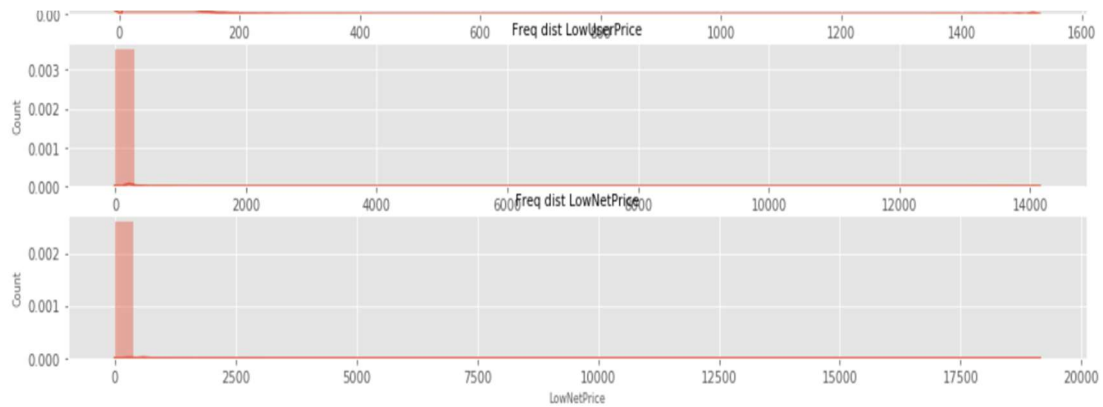
```
col_names = ['StrengthFactor', 'PriceReg', 'ReleaseYear', 'ItemCount', 'LowUserPrice', 'LowNetPrice']

fig, ax = plt.subplots(len(col_names), figsize=(16,12))

for i, col_val in enumerate(col_names):

    sns.distplot(sales_data_hist[col_val], hist=True, ax=ax[i])
    ax[i].set_title('Freq dist '+col_val, fontsize=10)
    ax[i].set_xlabel(col_val, fontsize=8)
    ax[i].set_ylabel('Count', fontsize=8)
```





14.3.ML Modelling

➤ Test-train split

```
[18]: x_train, x_val, y_train, y_val = train_test_split(training_features, training_target,
                                                    test_size = .1,
                                                    random_state=12)
```

➤ Classification model for predicting the SKU needs to be kept or not

```
In [20]: clf_rf = RandomForestClassifier(n_estimators=25, random_state=12)
         clf_rf.fit(x_train_res, y_train_res)

Out[20]: RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                                max_depth=None, max_features='auto', max_leaf_nodes=None,
                                min_impurity_decrease=0.0, min_impurity_split=None,
                                min_samples_leaf=1, min_samples_split=2,
                                min_weight_fraction_leaf=0.0, n_estimators=25, n_jobs=None,
                                oob_score=False, random_state=12, verbose=0, warm_start=False)
```

➤ Prediction results

```
print('Validation Results')
print(clf_rf.score(x_val, y_val))
print(recall_score(y_val, clf_rf.predict(x_val)))

pred = clf_rf.predict(testing_features)

print('\nTest Results')
print(clf_rf.score(testing_features, testing_target))
print(recall_score(testing_target, pred))

print('\nROC AUC score')
print(roc_auc_score(testing_target, pred))
```

```
Validation Results
0.8044407894736842
0.325426944971537
```

15. Conclusion

The AI-powered inventory management service offers a transformative solution for small-scale and medium businesses seeking to optimize their inventory operations. By harnessing the power of advanced artificial intelligence and machine learning algorithms, businesses can gain valuable insights and make data-driven decisions to enhance their inventory management practices. The model uses a subscription B2B based financial model. By adequate partnerships revenue generation through commissions is also possible.