

E-COMMERCE LOGISTICS

SELLER RISK PROFILING, AND REVIEW FRAUD DETECTION

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INTRODUCTION

The Dataverse Africa July Challenge aimed to address critical issues faced by AfriMarket, a fictional e-commerce platform, experiencing rising customer dissatisfaction due to complaints, fake reviews, slow deliveries, and unreliable sellers. As a Data Intelligence Officer, my mission was to analyze the marketplace data, identify fraudulent patterns, and recommend a seller trust framework to restore customer confidence in Nigeria and Ghana.

DATASET OVERVIEW

The analysis utilized a three-month log of marketplace activity, encompassing various attributes:

- Order ID: Unique transaction identifier
- Order Date, Dispatch Date, Delivery Date: Timestamps for order placement, dispatch, and delivery
- Seller ID: Unique code for each seller
- Product Category: Types of products sold (e.g., Electronics, Fashion)
- Price and Quantity: Price per unit and quantity ordered
- Warehouse Zone: Origin of shipment (e.g., Lagos, Accra)
- Customer Rating: Rating scale from 1 to 5
- Review Text: Optional customer feedback
- Sentiment Score: Derived from review text
- Return Flag: Indicator if the item was returned
- Complaint Code: Type of complaint (e.g., Late Delivery)
- Delivery Method: Options such as Express or Standard
- Customer Region: Broad location of customers
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RAW DATA SAMPLE

Order ID	Order Date	Dispatch Date	Delivery Date	Seller ID	...	Sentiment Score	Return Flag	Complaint Code	Delivery Method	Customer Region
00000	2025-05-28	2025-05-30	2025-06-06	S033	...	0.458333	No	No Complaint	Express	North Central
00001	2025-06-24	2025-06-26	2025-07-03	S018	...	0.458333	No	No Complaint	Standard	Volta

CLEANED DATA SAMPLE

order_id	order_date	dispatch_date	delivery_date	seller_id	...	return_rate	average_rating	complaint_rate	avg_delay	seller_risk_score
00000	2025-05-28	2025-05-30	2025-06-06	S033	...	0.041667	3.166667	1.0	5.208333	0.437339
00001	2025-06-24	2025-06-26	2025-07-03	S018	...	0.050000	3.200000	1.0	3.000000	0.431727

METHODOLOGY

The analysis comprised several key steps, including data cleaning, feature engineering, predictive modeling, and visual analytics.

Data Cleaning:

- Standardized column names and ensured consistency in categorical entries.
- Handled missing values using forward fill and median imputation methods.
- Identified and flagged suspicious reviews based on length and duplication.

Feature Engineering:

- Created new features such as delivery delay, return rates, and seller risk scores.
- Aggregated seller metrics to evaluate performance effectively.

Predictive Modeling:

- Built classification models using Random Forest and Logistic Regression to predict return flags.
- Addressed class imbalance through SMOTE to enhance model performance.

Visual Analytics:

- Generated visualizations to identify patterns in seller performance, customer complaints, and delivery delays.
- Conducted statistical tests (ANOVA) to assess the significance of delivery methods on customer ratings.

TASK 1: DATA CLEANING & FEATURE ENGINEERING

OBJECTIVES

The first task focused on cleaning the dataset and engineering new features to evaluate seller reliability and risk. Key steps included:

- **Standardizing Entries:** Ensured consistency in city, seller, and category entries.
- **Handling Missing Values:** Filled missing data using forward fill methods, median values, and set defaults where appropriate.

Feature Engineering:

- **Delivery Delay:** Calculated as the difference between delivery and dispatch dates.
- **Seller Metrics:** Computed return rates, average ratings, and complaint rates for each seller.
- **Suspicious Review Flags:** Identified reviews with duplicate content or unusually short lengths.

SELLER RISK SCORE

A weighted formula was developed to calculate a Seller Risk Score, incorporating factors such as return rates, complaint rates, and average delivery delays. This score facilitates the identification of high-risk sellers.

COMPLETION OF TASK 1

The data cleaning and risk score engineering were successfully completed, yielding a cleaned dataset ready for further analysis.

TASK 2: PATTERN SURVEILLANCE

OBJECTIVES

The second task employed analytics and visualizations to uncover patterns in seller performance and customer feedback:

- **Top and Bottom Sellers:** Identified sellers based on fulfillment reliability.
- **Complaint Analysis:** Highlighted product categories with the highest complaint rates.
- **Delivery Delay Insights:** Analyzed regions with the longest average delivery delays.
- **Review Fraud Detection:** Spotting patterns in reviews, particularly those with repetitive texts or high ratings coupled with high return rates.

HYPOTHESIS TESTING

An **ANOVA test** was conducted to evaluate if the delivery method affects customer ratings. The results indicated:

F-statistic: 0.87

P-value: 0.418

CONCLUSION: No statistically significant difference in ratings based on delivery method.

VISUALIZATION/CHART SUMMARIES

Visual insights were generated, providing valuable information for decision-making.

1. Distribution of Delivery Methods

Objective: Understand which logistics options are most frequently used.

Insight: Standard and Express deliveries dominate, with little use of alternatives.

Recommendation: Prioritize resources for the most-used methods; consider phasing out underutilized ones.

2. Top Ordered Product Categories

Objective: Identify the most popular product categories by order volume.

Insight: A small number of categories (e.g., Electronics, Fashion) account for most sales.

Recommendation: Focus marketing and inventory management on high-demand categories.

3. Customer Region Distribution

Objective: Understand where most customers are located.

Insight: Regions like Greater Accra and Lagos dominate order volumes.

Recommendation: Enhance regional delivery hubs and target localized promotions.

4. Complaints by Product Category

Objective: Identify categories that generate the most complaints.

Insight: Categories such as Fashion and Electronics have higher complaint volumes.

Recommendation: Audit suppliers and quality-check products in complaint-heavy categories.

5. Sentiment Score Distribution

Objective: Analyze overall customer sentiment from reviews.

Insight: Most reviews are neutral to positive, but some negative sentiment clusters exist.

Recommendation: Track negative spikes to intervene early with affected customers.

6. Return Flag Distribution

Objective: Measure the proportion of returned vs. non-returned orders.

Insight: Return rate is relatively low but still notable.

Recommendation: Investigate root causes for returns (e.g., defects, wrong sizing) and improve quality checks.

7. Average Rating per Product Category

Objective: Identify product categories with high or low customer satisfaction.

Insight: Categories like Electronics may be well-rated; others may underperform.

Recommendation: Promote highly-rated products and fix or delist poorly rated ones.

8. Sentiment Level Breakdown

Objective: Group sentiment into Positive, Neutral, and Negative for clarity.

Insight: Positive sentiment leads, followed by neutral and some negative feedback.

Recommendation: Leverage positive feedback in marketing and resolve negative trends swiftly.

9. Complaint Heatmap by Product Category & Region

Objective: Spot complaint patterns across regions and product types.

Insight: Some product-region combinations (e.g., Fashion in South West) show frequent issues.

Recommendation: Launch targeted seller training or audit in problem clusters.

10. Average Delivery Delay by Region

Objective: Identify regions experiencing delivery inefficiencies.

Insight: Certain regions (e.g., Lagos, North Central) have higher average delays.

Recommendation: Reassess logistics partnerships or routing strategies in delayed zones.

11. Top Predicted High-Return Sellers (Model Output)

Objective: Use a model to predict sellers with high return risk.

Insight: A few sellers consistently show high predicted return probabilities.

Recommendation: Investigate top risky sellers and take corrective action or suspension steps.

12. Top Sellers to Suspend or Investigate

Objective: Flag sellers with the highest overall risk score.

Insight: These sellers have poor performance across return, delay, and complaint metrics.

Recommendation: Suspend or audit top 5 risky sellers; monitor borderline cases.

13. Seller & Product Risk Summary Dashboard

Objective: Combine seller risk and product complaint data in one view.

Insight: Key sellers and categories emerge as clear outliers in risk.

Recommendation: Use dashboard regularly to support trust & safety team decisions.

14. Seller Risk Framework

Objective: Communicate the weighted components of the seller risk score.

Insight: Return rate and complaint rate carry the most weight (35–40% each).

Recommendation: Consider adjusting weights if new fraud indicators emerge (e.g., fake reviews).

15. Suspicious Sellers with Potential Fake Reviews

Objective: Flag sellers using suspiciously short and high-rated reviews.

Insight: Sellers with unusually short, duplicated 5-star reviews likely engage in fraud.

Recommendation: Integrate review length and duplication into future risk scoring models.

TASK 3: PREDICTION & RISK MODELING

OBJECTIVES

This task aimed to build a classification model to predict return flags based on key seller features:

Handling Class Imbalance: Utilized SMOTE to balance classes in the dataset.

Model Development: A Random Forest classifier was trained to predict return likelihood.

PERFORMANCE METRICS

CLASSIFICATION REPORT:

Precision: 0.99 (Class 0), 1.00 (Class 1)

Recall: 1.00 (Class 0), 0.67 (Class 1)

AUC Score: 0.8588

CONFUSION MATRIX:

True Negatives: 294

False Positives: 0

False Negatives: 2

True Positives: 4

HIGH-RISK SELLERS IDENTIFIED

The following sellers were flagged as high-risk:

Seller ID	Average Return Risk
S014	0.90
S041	0.89
S018	0.86

COMPLETION OF TASK 3

The model was trained, and risky sellers were identified and documented.

TASK 4: STRATEGY & RESOLUTION

RECOMMENDATIONS

1. Seller suspension and monitoring:

- Immediately suspend the top five high-risk sellers identified in the analysis (S039, S025, S040, S036, S016) to mitigate potential losses and restore customer trust.
- Implement a robust monitoring system to regularly assess seller performance metrics, allowing for proactive management of seller risks.

2. Blacklist problematic product categories:

- Enforce a temporary ban on product categories with high complaint rates, particularly Health, Electronics, Toys, Groceries, and Fashion, until quality assurance measures are established.
- Conduct supplier audits in these categories to ensure compliance with quality standards.

3. Enhance delivery operations:

- Reassign low-performing warehouses in regions experiencing high delivery delays, optimizing logistics to improve delivery times.
- Enforce strict dispatch timelines for sellers, ensuring adherence to agreed-upon delivery standards.

4. Actionable Strategies for Customer Trust:

- Develop transparent seller profiles that include ratings, reviews, and performance metrics, allowing customers to make informed purchasing decisions.
- Implement a 100% return guarantee on defective or delayed products to enhance customer confidence.
- Establish a 24/7 multilingual customer support system to address escalations and queries effectively.

5. Fraud detection mechanisms:

- Incorporate review length and duplication checks into the risk scoring system to identify and flag suspicious review patterns early.
- Regularly audit seller reviews to catch fraudulent activities, ensuring integrity in customer feedback.

6. Continuous improvement:

- Invest in advanced analytics and machine learning techniques to refine predictive models, enhancing their accuracy and effectiveness.
- Conduct periodic reviews of the seller trust framework to adapt to emerging market trends and customer needs.

BUSINESS CURVEBALLS

Lagos Warehouse Data Issues: Adjusted analysis for unreliable delay data due to warehouse overcapacity. Adjusted average delivery delays by excluding Lagos data.

Customer Region	Adjusted Average Delivery Delay
South West	4.7360
North Central	4.6429
South East	4.4892
Volta	4.4476
Greater Accra	4.3661
Ashanti	4.3303

Fake Reviews Detection: Identified warning signals for sellers with high ratings but suspicious review patterns, emphasizing the need for early intervention mechanisms.

POTENTIAL FAKE REVIEW SIGNALS

Seller ID	Customer Rating	Review Length	Suspicious Review Count
S003	5.0	9	1
S019	5.0	9	1
S031	5.0	9	1
S035	5.0	9	1
S043	5.0	9	1

CONCLUSION

The analysis conducted as part of the Dataverse Africa July Challenge has provided valuable insights into the operational challenges faced by AfriMarket. Through comprehensive data cleaning, feature engineering, and predictive modeling, we successfully identified key factors contributing to customer dissatisfaction, including slow deliveries, high return rates, and fraudulent review patterns. The implementation of a Seller Risk Score has enabled the identification of high-risk sellers, allowing for targeted interventions to improve overall marketplace integrity.

The statistical analysis revealed no significant differences in customer ratings based on delivery methods, suggesting that other factors may be more influential in shaping customer satisfaction. The findings underscore the necessity for AfriMarket to adopt a more nuanced approach to seller evaluation and customer service.

FUTURE WORK

Further exploration of advanced machine learning techniques and continuous monitoring of seller performance can enhance the predictive accuracy and operational efficiency of the platform. Regular audits of seller activities and customer feedback will be essential in upholding the integrity of the marketplace.