Report: Market Basket Analysis

1. Introduction

In today's competitive retail landscape, understanding purchasing patterns is critical to optimizing marketing, sales, and supply chain operations. This project applies **Market Basket Analysis (MBA)** to transactional data using the **Apriori algorithm** to discover associations between products. The results provide insights into frequently purchased product combinations and hidden relationships that can inform retail strategy.

2. Methodology

- **Dataset:** Customer transaction records containing product-level details.
- **Preprocessing:** Data was cleaned, formatted into a transaction–item structure, and prepared for association rule mining.
- **Algorithm:** The **Apriori algorithm** was applied to generate frequent itemsets and association rules.
- **Evaluation Metrics:**
    - **Support** (frequency of occurrence)
    - **Confidence** (conditional probability of purchase)
    - **Lift** (strength of association compared to chance)

3. Key Findings

The analysis uncovered several strong product associations:

1. **Kitchen Towels → UHT Milk**
    - Support: 0.23%
    - Confidence: 30%
    - Lift: 3.82
      Interpretation: Customers who buy kitchen towels are significantly more likely to also purchase UHT milk.

2. **Potato Products → Beef**
    - Support: 0.26%
    - Confidence: 45%
    - Lift: 3.80
      Interpretation: A strong complementary relationship exists between meat and potato-based items, highlighting meal-prep behavior.
3. **Canned Fruit → Coffee**
    - Support: 0.23%
    - Confidence: 43%
    - Lift: 3.73
      Interpretation: Indicates a less obvious but interesting pairing, suggesting bundled promotions for snacks and beverages.
4. **Meat Spreads → Domestic Eggs**
    - Support: 0.36%
    - Confidence: 40%
    - Lift: 3.00
      Interpretation: Strong breakfast-related purchase pattern.
5. **Flour ↔ Mayonnaise**
    - Support: 0.23%
    - Confidence: 6–12%
    - Lift: 3.34
      Interpretation: Despite lower confidence, the high lift suggests a niche but significant co-purchase behavior.

4. Business Implications

The findings support actionable retail strategies:

- **Product Placement:** Place highly associated products together (e.g., beef near potato products, UHT milk near kitchen towels).

- **Cross-Selling Campaigns:** Create bundled offers (*“Buy flour, get a discount on mayonnaise”*).
- **Promotion Design:** Promote unexpected pairings (e.g., canned fruit + coffee) to drive additional sales.
- **Inventory Optimization:** Ensure a consistent stock of frequently paired items to prevent lost opportunities.

5. Limitations

- The analysis reflects **historical data**, which may not account for recent market shifts or seasonal demand.
- Some rules show high lift but relatively low support, indicating niche but important associations.
- Scaling to very large datasets may require **FP-Growth** or other efficient algorithms.

6. Conclusion

This Market Basket Analysis revealed both intuitive and hidden product relationships. By leveraging these insights, the business can improve **in-store layouts, cross-selling promotions, and supply chain planning**. Overall, the analysis demonstrates the potential of a data-driven retail strategy to boost customer satisfaction and revenue.