**Leveraging Machine Learning for Predicting Agricultural Trade Flows Between Nigeria and Its Trading Partners**

**Overview**

This project investigates the application of machine learning techniques to predict agricultural trade flows between Nigeria and 70 of its trading partners. The research analyzes panel data spanning from 1996 to 2021, identifying key determinants of trade and comparing the predictive performance of machine learning algorithms to traditional econometric methods.

**Objectives**

Compare the performance of various machine learning algorithms in predicting agricultural trade flows.

Identify the significant features influencing trade flows between Nigeria and its partners.

Provide accurate trade flow predictions to support data-driven policymaking.

**Data and Methodology**

**Data Description**

The dataset includes information on 70 trading partners of Nigeria, incorporating:

1. **Economic indicators:** GDP of Nigeria and partner countries.
2. **Demographics:** Population of Nigeria and partner countries.
3. **Geographical factors:** Distance between Nigeria and trading partners, landlocked status, and common language.
4. **Trade metrics:** Import and export values.
5. **Exchange rates:** Annual average nominal exchange rates for Nigeria and partner countries.

**Data Pre-processing**

**Integration and Cleaning:** Consolidation of data from multiple sources, handling missing values through interpolation and encoding categorical variables.

**Normalization:** MinMax scaling applied to ensure compatibility with machine learning algorithms.

**Algorithms Evaluated**

**Machine Learning Models:**

1. Linear Regression (including Ridge and Lasso variants)
2. Random Forest
3. Gradient Boost Regression
4. Neural Networks

**Evaluation Metrics:**

1. R-squared (R²)
2. Mean Squared Error (MSE)
3. Root Mean Squared Error (RMSE)

**Results**

**Predictive Performance**

**Agricultural Imports:**

1. **Best Model:** Random Forest
2. **R-squared:** 0.75
3. **MSE:** 3.60699E+15
4. **RMSE:** 60058189.05

**Agricultural Exports:**

1. **Best Model:** Random Forest
2. **R-squared:** 0.41
3. **MSE:** 8.82E+15
4. **RMSE:** 93929485.26

**Feature Importance (Agricultural Imports)**

1. GDP of partner countries: 37%
2. Population of partner countries: 28.5%
3. Exchange rate of partner countries: 13.9%
4. Exchange rate of Nigeria: 6.1%
5. Population of Nigeria: 5.5%
6. GDP of Nigeria: 4.8%
7. Distance: 3.6%
8. Landlocked: 0.3%
9. Common Official Language: 0.2%

**Summary Statistics**

**Average GDP (Nigeria):** $302 billion

**Average GDP (Partners):** $785 billion

**Average Import Value:** $55 million

**Average Export Value:** $14 million

**Average Distance:** 5,864 km

**Insights and Recommendations**

1. **Adopt Machine Learning Models:** Random Forest significantly outperforms traditional econometric models, especially for import predictions. Incorporating such models into trade analysis can improve accuracy and reliability.
2. **Address Logistical Challenges:** Distance remains a limiting factor. Investment in infrastructure can mitigate this effect.
3. **Leverage Key Features:** Focus on GDP and population of partner countries to develop targeted trade agreements and strategies.
4. **Policy Implications:** Policymakers should consider machine learning insights when crafting trade policies to enhance Nigeria’s agricultural competitiveness.

**Conclusion**

This research demonstrates the potential of machine learning, particularly Random Forest, in accurately predicting agricultural trade flows. By identifying significant factors influencing trade, the study provides actionable insights for policymakers and stakeholders to strengthen Nigeria’s position in global agricultural trade.

**Appendix**

**Data Source:** World Integrated Trade Solutions (WITS), World Development Indicators (WDI), <https://www.geodatos.net/en/distances/country/nigeria#google_vignette>,

<https://www.surfertoday.com/environment/the-complete-list-of-landlocked-countries>, and World Factbook Glyph.