

Group 1

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Analysing U.S. Food Import Trends Using Regression Analysis and Machine Learning

Abstract

This report explores the evolution of U.S. food import patterns using a data-driven approach. By applying statistical and machine learning methods to a comprehensive dataset from Data.gov, we examine trends in import volumes and values, identify correlations between prices and quantities, forecast future trends, and assess volatility across food categories. Our goal is to inform supply chain resilience strategies by leveraging data insights. This analysis highlights how different food categories behave under economic and global pressures, providing actionable insights for policymakers, supply chain managers, and importers.

Research Questions

This project aims to answer the following research questions:

1. How have food import volumes and values evolved over time?
2. What is the relationship between prices and import volumes?
3. Can we forecast future import trends using statistical models?
4. Which food categories demonstrate high volatility in import patterns?
5. What prescriptive actions can be taken to improve the resilience of the food import supply chain?

Data Discussion and Sources

We used publicly available data from the U.S. government:

Source: U.S. Food Imports – Data.gov

The dataset includes:

Import Value and Volume across 18 food categories.

Key Food Categories Analyzed:

Animals, Meats, Fruits, Vegetables, Grains, Dairy and Fish

Analytical Methods

Data Cleaning and Preprocessing

- Data standardized for visualization and modeling.

Exploratory Data Analysis (EDA)

- **Trend lines** for value and volume per category.
- **Scatter plots** for price-volume relationships.

Statistical Techniques

- **Time series trends** plotted for import value and volume (2000–2025).
- **Correlation analysis** conducted using Pearson's coefficient.
- **Regression-based forecasting** to project future trends up to 2030
- **Volatility** computed as YoY % change in import value.

Results

Import Value and Volume Trends

- **Animals and Meats** showed consistent growth in both volume and value, indicating increased domestic consumption or shifts in trade partnerships.
- **Fruits and Vegetables** exhibited seasonal spikes, with values increasing faster than volumes—suggesting rising prices or increased demand for premium imports.
- **Grains** displayed **significant volatility**, likely influenced by weather patterns, tariffs, or geopolitical disruptions.
- **Dairy and Fish** imports showed upward trends in value despite relatively stable or declining volumes, implying that **prices are rising faster than demand**.

Price–Volume Relationship

- A **general inverse relationship** was found between price and volume across categories. For instance:
 - **Meats and Fish**: As prices rose, import volumes decreased.
 - **Grains**: A weaker correlation, potentially due to inelastic demand or stockpiling strategies.
- Some categories (e.g., Cocoa, Coffee) displayed **inelastic trends**, where volume remained constant despite price increases, likely due to their status as essential commodities or ingredients.

Forecasting and Volatility

- Forecasting models predicted continued growth in high-demand imports (e.g., Fruits, Meats), though subject to seasonal fluctuation.
- **Stable categories** included Beverages and Sweets, with predictable import behavior.

Conclusions and Recommendations

Key Conclusions

- U.S. food imports are generally growing in both value and volume, with differentiated behavior across categories.
- Price elasticity varies significantly: some categories show traditional demand response, while others (like Cocoa and Coffee) do not.
- Volatility is concentrated in a few categories—primarily grains and perishable vegetables—requiring active risk management.

- Forecasting tools are effective for projecting short-term trends, supporting strategic procurement.

Prescriptive Recommendations

- **Supply Chain Diversification:**
For volatile categories (e.g., Grains, Fish), establish multi-region sourcing to mitigate disruptions from climate or conflict.
- **Demand Forecasting Tools:**
Invest in predictive analytics dashboards for inventory and procurement planning, especially for high-value or perishable goods.
- **Policy and Trade Strategy Alignment:**
Use volatility indicators to inform tariff negotiations and import/export policy.
- **Resilience Planning:**
Develop buffer stock strategies for categories with volatile volume/price behavior.
- **Further Research:**
Integrate climatic, trade policy, and logistics data for a more holistic risk model.

Category-Specific Insights:

Meats

U.S. beef imports have grown significantly due to trade agreements and supply-demand gaps. Higher prices generally lead to volume drops, indicating price sensitivity.

Reference: Southern Ag Today. (2024, August 27). *U.S. beef imports: A quick look at recent trends*. <https://southernagtoday.org/2024/08/27/u-s-beef-imports-a-quick-look-at-recent-trends/>

Seafood

U.S. seafood imports are expanding due to a repositioning of the domestic aquaculture industry, with increased imports from Southeast Asia.

Reference: USDA Economic Research Service. (2024, May). *U.S. seafood imports expand as domestic aquaculture industry repositions itself*. <https://www.ers.usda.gov/amber-waves/2024/may/u-s-seafood-imports-expand-as-domestic-aquaculture-industry-repositions-itself>

Dairy

Shipping disruptions and policy changes have impacted U.S. dairy trade, with growth in demand from Mexico and Canada.

Reference: Southern Ag Today. (2025, January 9). *2025 U.S. agricultural trade outlook: Navigating uncertainty amid policy shifts*. <https://southernagtoday.org/2025/01/09/2025-u-s-agricultural-trade-outlook-navigating-uncertainty-amid-policy-shifts>

Fruits

Florida citrus production has declined due to disease and weather, increasing reliance on imports from Mexico and Brazil.

Reference: Southern Ag Today. (2024, January 5). *Citrus greening, hurricanes, and the decline of the Florida citrus industry*. <https://southernagtoday.org/2024/01/05/citrus-greening-hurricanes-and-the-decline-of-the-florida-citrus-industry>

Vegetables

The termination of the 2019 Tomato Suspension Agreement may impose a 21% duty on Mexican tomatoes, disrupting supply chains.

Reference: Southern Ag Today. (2025, May 1). *Tomato trade wars: How the suspension agreement with Mexico shapes the U.S. market*. <https://southernagtoday.org/2025/05/01/tomato-trade-wars-how-the-suspension-agreement-with-mexico-shapes-the-u-s-market>

Grains

WASDE projections show increased grain supply but lower prices. Sorghum premiums fell due to lower exports, especially to China.

References: Southern Ag Today. (2024, May 13). *May WASDE projects higher supplies and lower prices again in 2024*. <https://southernagtoday.org/2024/05/13/may-wasde-projects-higher-supplies-and-lower-prices-again-in-2024>

Southern Ag Today. (2025, January 22). *Export challenges drive down sorghum premiums*. <https://southernagtoday.org/2025/01/22/export-challenges-drive-down-sorghum-premiums>

Findings:

- **Price-Volume Dynamics:** Meat and seafood categories are price sensitive; dairy shows modest elasticity.
 - **Seasonality:** Fruits and vegetables show strong seasonal trends.
 - **Volatility:** Grains show high volatility due to global disruptions.
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Recommendations:

- **Fruits & Vegetables:** Diversify sourcing and invest in regional greenhouses to mitigate seasonality and tariff risks.
- **Grains:** Use futures contracts and diversify import sources to reduce exposure to global volatility.
- **Meats & Dairy:** Monitor regulatory changes and negotiate long-term supplier contracts.
- **Seafood:** Encourage domestic aquaculture investment and reduce reliance on imports.

Conclusion:

U.S. food imports show category-specific dynamics influenced by global trends, trade policy, and domestic disruptions. A data-informed, category-tailored sourcing strategy can enhance supply chain resilience and cost efficiency.

APA References: Southern Ag Today. (2024, August 27). *U.S. beef imports: A quick look at recent trends*. <https://southernagtoday.org/2024/08/27/u-s-beef-imports-a-quick-look-at-recent-trends/>

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