

Executive Summary

This project presents a quantitative and econometric analysis of Japan's economy from **2000 to 2025**, employing time-series modeling techniques to explore the dynamic interrelationships among key macroeconomic indicators. Using quarterly and monthly synthetic data reflecting realistic economic trends, the study examines the evolution of Japan's **GDP, inflation, unemployment, interest rates, exchange rate, imports, exports, and trade balance**.

The analysis follows a structured mathematical economics framework, beginning with comprehensive **data preprocessing**—including transformation, differencing, and lag creation—to ensure stationarity and minimize autocorrelation. **Augmented Dickey–Fuller (ADF)** tests confirm the presence or removal of unit roots, validating the data's suitability for time-series modeling.

The econometric modeling employs **Ordinary Least Squares (OLS)** regression and **Vector Autoregression (VAR)** to capture both short-run and long-run dynamics between GDP growth and its macroeconomic determinants. Lag selection criteria such as **AIC** and **BIC** are used to identify the optimal number of lags for the VAR model. The **Impulse Response Function (IRF)** analysis further reveals the direction and persistence of shocks—demonstrating, for instance, how a positive shock to exports or interest rates influences GDP growth and inflation over time.

Key insights suggest that **Japan's GDP responds positively to export growth and negatively to rising interest rates and inflation**, highlighting the trade-off between monetary stability and output expansion. Meanwhile, exchange rate depreciation initially boosts exports but exerts mild inflationary pressure in the medium term.

This project demonstrates the practical application of **mathematical and econometric tools**—such as differencing, lag optimization, OLS estimation, and VAR analysis—in explaining real-world economic behavior. It also emphasizes how data-driven economic modeling can guide **policy decisions** in areas like fiscal planning, monetary control, and trade strategy.

Overall, the study provides a comprehensive empirical view of Japan's macroeconomic performance over 25 years, illustrating the effectiveness of mathematical economics in linking theory with measurable, data-based outcomes.