Exploratory Phase: Using Google Trends data and Machine Learning to Nowcast Quarterly GDP in Nigeria

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Category: Economic Statistics

(Source: Stock images)

Introduction

Calculating quarterly Gross Domestic Product (GDP) requires integrating data from multiple sources, including government records, business surveys, and financial reports. This data often takes 2-3 months (or longer) to become available after the reporting period, making it difficult for policy and decision makers to have a real-time understanding of the economy.

For this reason, global governments and policymakers are increasingly seeking early economic insights from *proxy indicators* that may provide early signals of economic change, which in turn can support more timely decisions or interventions. It can also reduce the dependency of running costly and time-consuming surveys by the National Statistics Office (NSO), through the use instead of easily accessible alternative data.

A nation's Google Trends data can be used to nowcast GDP, to predict the current or near-current GDP before official reports are released.

What is Google Trends Data?

Google Trends data uses historical country-based search queries that reflect real-time economic sentiment based on people's search behaviour. For example, an increase in searches for luxury travel, real estate investment, or hiring trends may indicate economic growth, while spikes in searches for loan defaults, unemployment benefits, and debt consolidation may signal economic distress.

Google Trends data is high-frequency, and is available at monthly intervals as well as in real-time, providing a dynamic snapshot of a nation's prevailing economic conditions.

What did we do?

In December 2024, the African Centre for Statistics (ACS) of the UN Economic Commission for Africa (UN ECA) ran a week-long workshop at the National Bureau of Statistics in Abuja, Nigeria, focused on the application of Nigerian Google Trends data and various Machine Learning (ML) Models for calculating an estimate (a proxy) for Nigeria's Quarterly GDP. National Accounts experts from the NSOs of Nigeria, Cameroon, Kenya, Egypt, Côte d'Ivoire, Mauritius and Ghana also attended.

The key goals of the training were to:

- Integrate high-frequency Nigerian Google Trends data into GDP forecasting models.
- Compare ML algorithms to determine the most accurate approach for nowcasting Nigeria's Quarterly GDP.
- Deliver the knowledge and skills to participating NSO National Accounts experts, enabling them to return and apply their new learning to their own national Google trends data.

Today, we are sharing the technical approach and results from the workshop. Links are shared to the data used during the training, as well as the web application applied to capture the Google Trends data.

For the full data science project information, please refer to the technical write-up here - https://yonsci.github.io/gdp-nowcasting-ml/09-implement-ml-models-to-nowcast-gdp/

Technical Approach

Data Sources

Two specific data sources were used during the workshop:

- **Quarterly Gross Domestic Product (GDP):** Official quarterly Gross Domestic Product (GDP) data obtained from the Nigerian Bureau of Statistics (NBS) spanning the years 2010 to 2024. The data can be found via this link.
- **Google Trends**: Google Trends data for Nigeria was harvested from the Google Trends dataset for the same period utilizing a web application developed internally within the African Centre for Statistics (ACS) to facilitate the data collection.

Workflow

The GDP Nowcasting workflow is highlighted in Figure 1 below, with further information shared on the data sources used, the data Preprocessing stage and the Model Training & Forecasting phase.

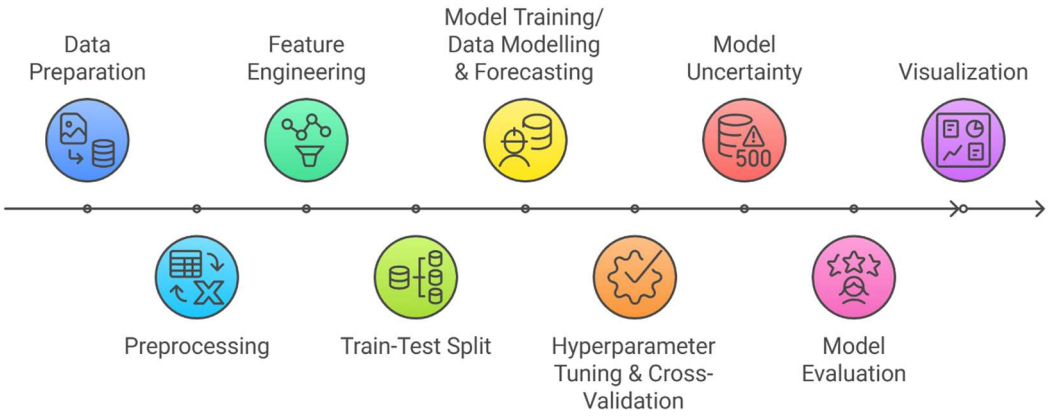

Figure 1. GDP Nowcasting Workflow

The data preprocessing phase is shared in Figure 2, highlighting the steps taken to prepare the data for further analysis.

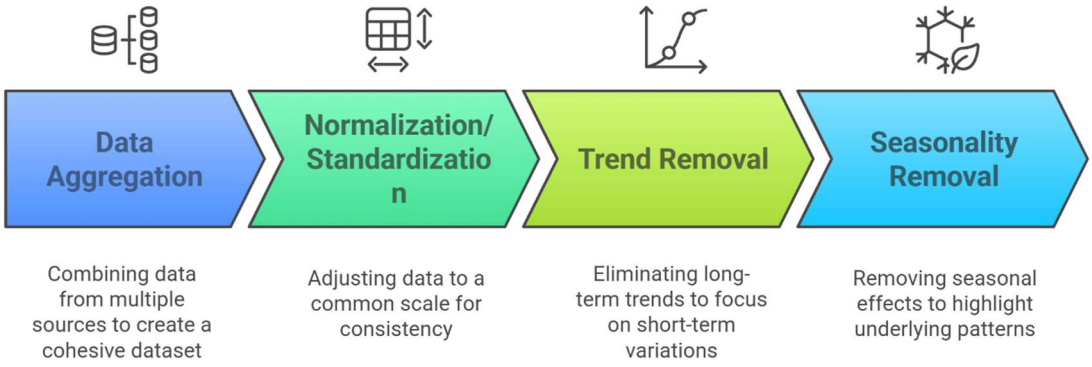

Figure 2. Data Preprocessing phase

- **Data Aggregation:** Converting monthly Google Trends data into quarterly.
- **Normalization/Standardization:** Adjusting each variable to a common scale, so large-value features don't dominate the model.
- **Trend Removal:** Stripping away long-term upward or downward drifts in GDP, letting us focus on short-term or cyclical fluctuations.
- **Seasonality Removal**: Subtracting repeating seasonal effects such as quarter-to-quarter spikes so the underlying patterns in the data are more apparent for accurate nowcasting.

Model Training & Forecasting

Nine different machine learning algorithms were trained on the final data set, as shown in Figure 3 below.

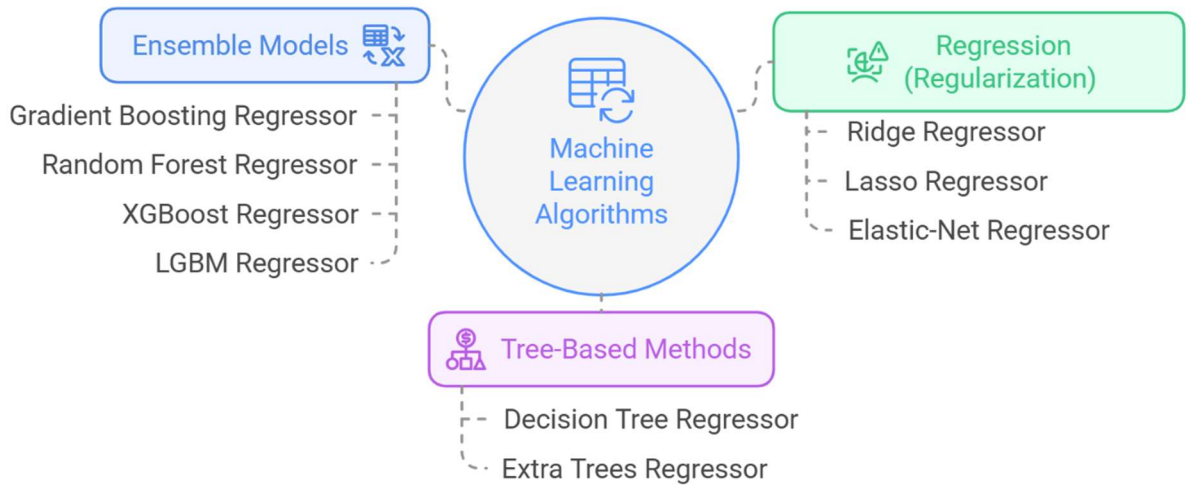

Figure 3. Machine Learning Models applied to the data

Two forecasting methods were employed:

1. One-step forecast: predicting GDP one-quarter ahead using historical data.
2. Rolling forecast: iteratively updating predictions based on newly available Google Trends data.

Initial Results

By integrating Google Trends data with the LGBM Regressor machine learning model, it was possible to achieve ~87% accuracy (R^2) in nowcasting Nigeria's GDP for the period 2022 – 2024. The predicted GDP results using the LGBM Regressor are shown in Figure 4 below.

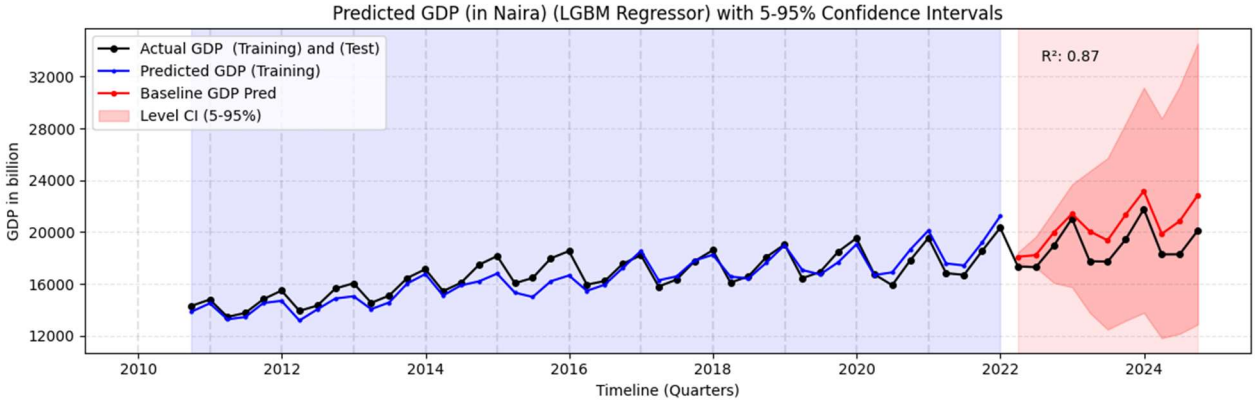

Figure 4. Predicted GDP, using the LGBM Regressor, for Nigeria 2022 – 2024

The results demonstrate the potential to provide a real-time proxy indicator for GDP, that can be used to provide early insights to economic downturns and booms. The method provides a cost-effective, real-time solution for economic forecasting, paving the way for faster decision-making and policy adjustments in response to economic fluctuations.

Future Project Enhancements

Some potential project enhancements are suggested for future consideration:

- **Real-Time Dashboard**: It would be possible to integrate these predictions into a live Streamlit or Power BI interface, enabling all stakeholders to view real-time updated forecasts.
- **Domain specific Google Trends**: It would be possible to focus on more specific Google Trends terms to deliver more granularity to the results, for example, through exploring domain-specific searches for say agriculture, oil, or manufacturing.
- **Advanced deep learning time-Series models**: There are some advanced deep learning time series models that could be explored for their relevance and possible accuracy improvements, for example, Recurrent Neural Network, Long Short Term Memory, Gated Recurrent Unit, Transformer, Temporal Fusion Transformer, Encoder decoder LSTM, and Sequence to Sequences with attention structures to capture seasonality more directly.

Other NSO Applications

The National Accounts experts who received the training from the NSOs of Kenya, Egypt, Cameroon, Côte d'Ivoire, Ghana, and Mauritius are currently experimenting with the GDP nowcasting methodology, and we will share the results of their findings in the near future via the UN Regional Hub for Big Data and Data Science for Africa.