



**MORINGA**

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# ANALYSING, FORECASTING & PREDICTING FINANCIAL TRENDS

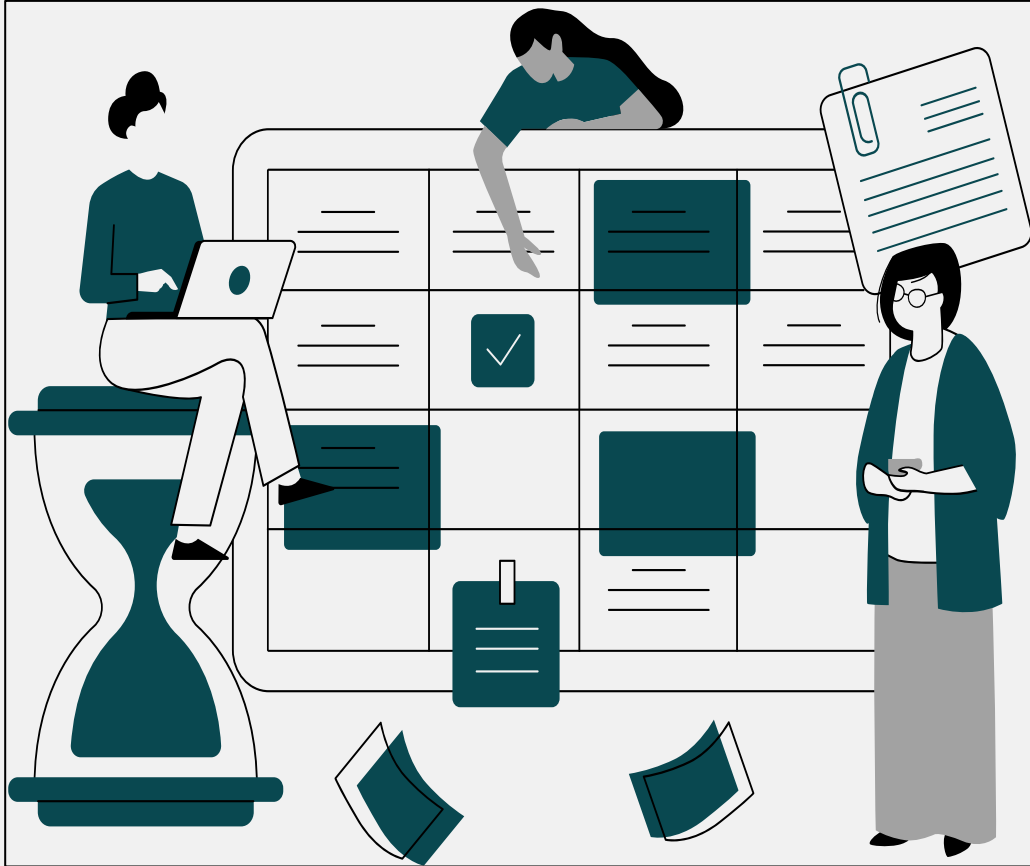
## TIME SERIES MODELING



# TARGET AUDIENCE



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# GOVERNMENT'S COMMITMENT

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- Passed to law by Parliament on 26<sup>th</sup> June 2023
- Sealing Revenue Leakages Through Tax Avoidance & Evasion
- Contain Expenditures & Boost Revenues 
- Measure of Success: Tax as a %ge of **GDP > 15%** by 2023/2024



# DEBUNKING THE NUMBERS



Expenditure

## KES. 3.7T

**Total Approved Budget**  
**Set aside to meet BETA priorities**  
**22% of GDP**

**KES. 700B**  
Budget Deficit  
20% of **GDP**  
External & Domestic  
Financing



## KES. 2.6T

Tax Revenue Collections  
71% of Total Budget  
16% of **GDP**

## KES. 0.4B

Ministerial-Appropriation-in-Aid  
9% of Total Budget  
2% of **GDP**

## KES. 3.0B

Total Projected Revenues  
80% of Total Budget  
18% of **GDP**

Revenue: Funding Plan?

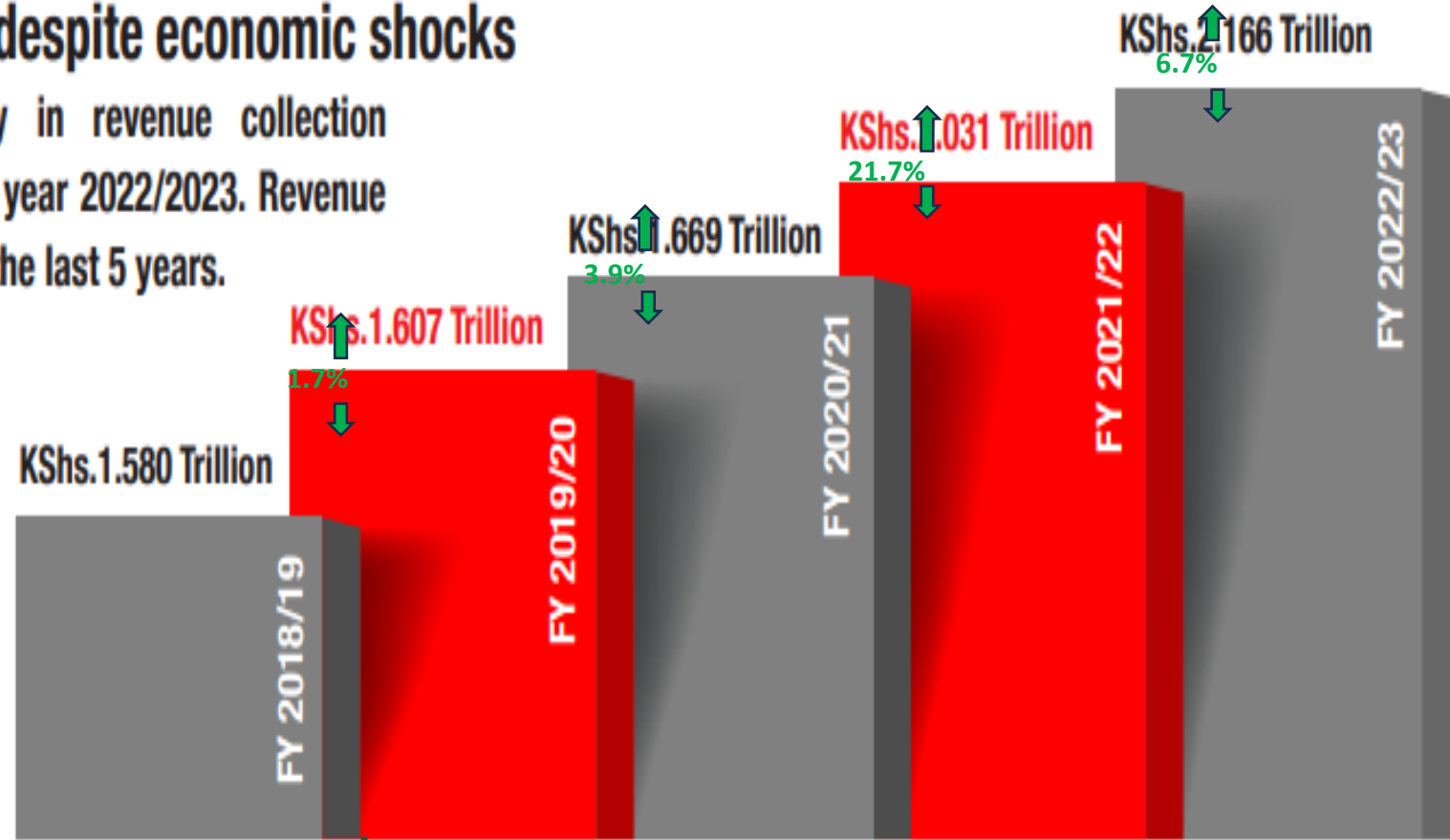
# TAX REVENUE : COLLECTION TRENDS

## KRA sustains revenue growth despite economic shocks

KRA maintained an upward trajectory in revenue collection recording a 6.7% growth in the financial year 2022/2023. Revenue collection has progressively increased in the last 5 years.



**5-YEAR REVENUE GROWTH**  
**KShs. 586.259 Billion**



**Kes. 2.9 Trillion FY 2023/24 Gov't Target (32% YoY Growth)???**

Government views the ratio of tax revenue as a percentage of GDP below acceptable levels to enable spur economic growth & reduce cost of living.

# TAX-GDP RATIO

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*What Is a Good*

*Tax-to-GDP-*

*>15%*

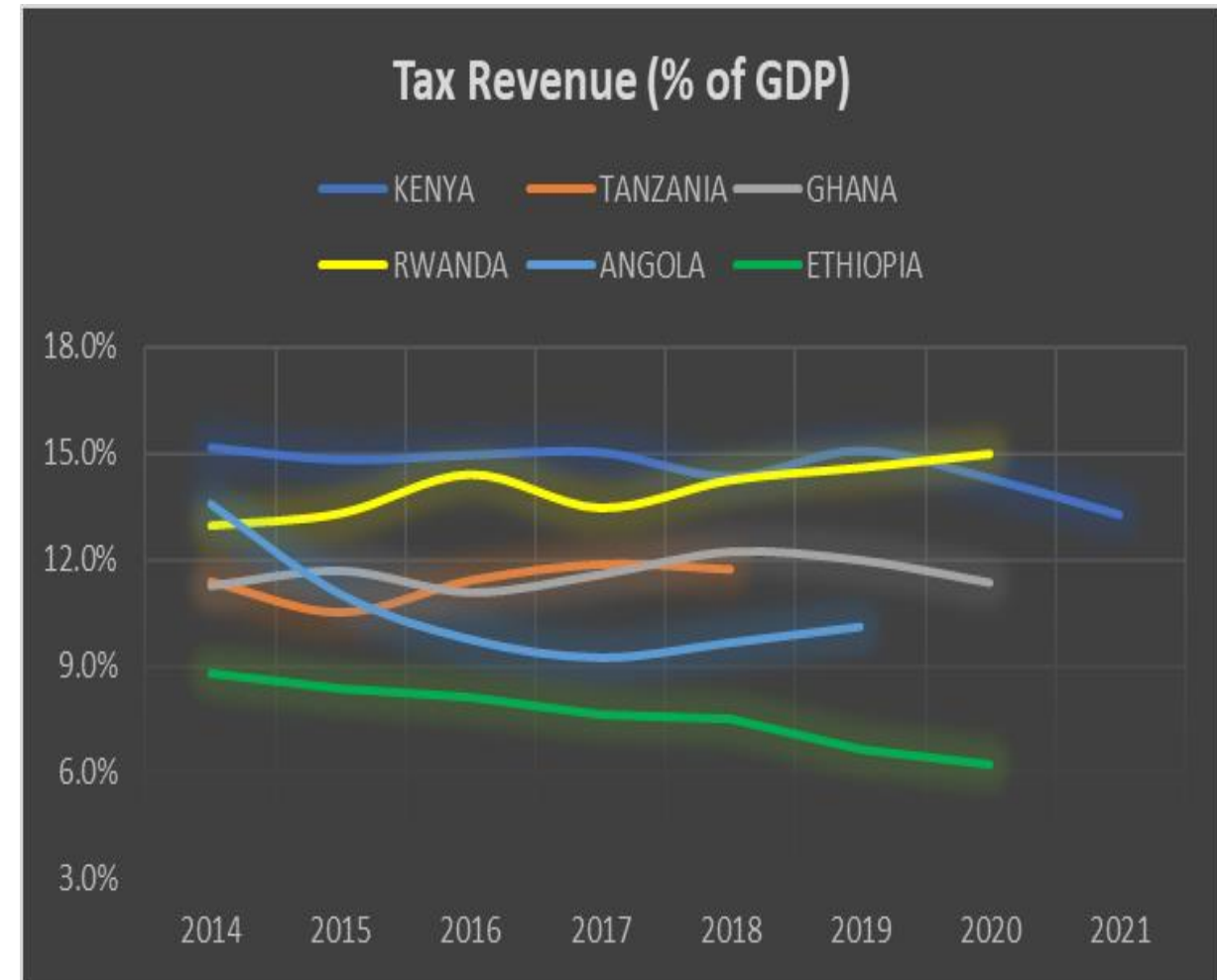
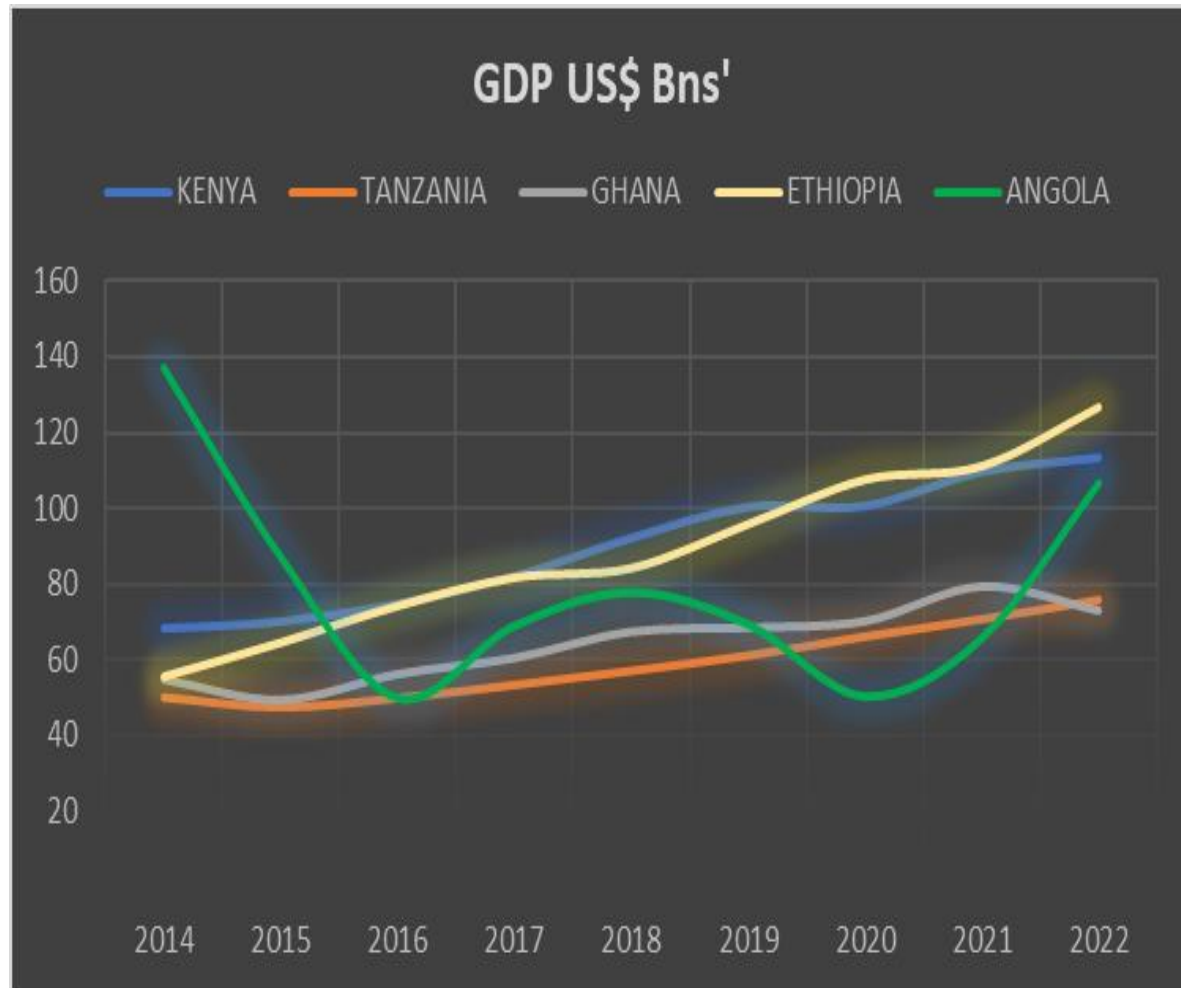
*Ratio?*

A tax-to-GDP ratio of 15% or higher ensures economic growth and, thus, poverty reduction in the long-term, according to the World Bank

- Measure of a Nation's tax revenue relative to the size of its economy
- This ratio is used with other metrics
- Determines how well a Nation's Government directs its economic resources via taxation.



# GDP LEAGUE TABLE

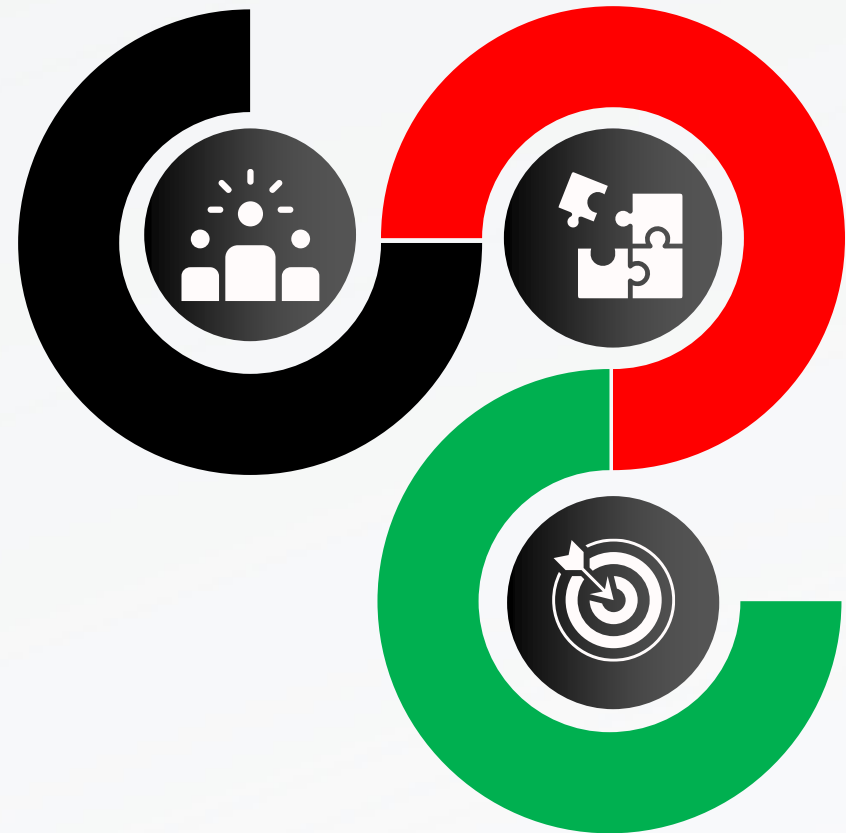


**Is GDP Growing Proportionately To Projected Tax Revenue Collections?**  
**Are There Alternative Solution To Spur Economic Growth?**



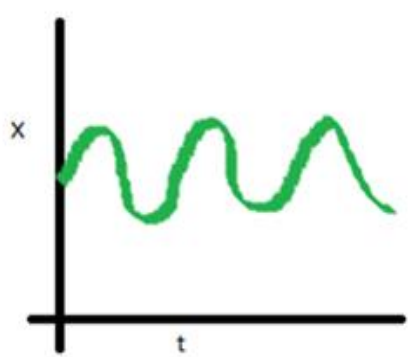
# GOALS & OBJECTIVES

- The goal of the project is to study how Kenya's economy has performed in the past (GDP trends) and use that information to predict how it might grow in the future.
- Project aims to analyze Country's historical GDP trends and forecast future GDP growth using Machine Learning Algorithm.
- The analysis shall assist provide insights into economic growth patterns, identify emerging trends, and support evidence-based decision-making for various stakeholders.

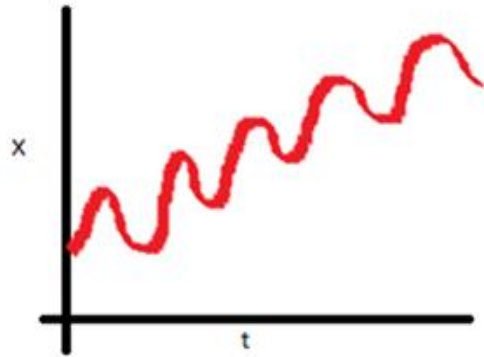


# TERMINOLOGIES & CONCEPTS

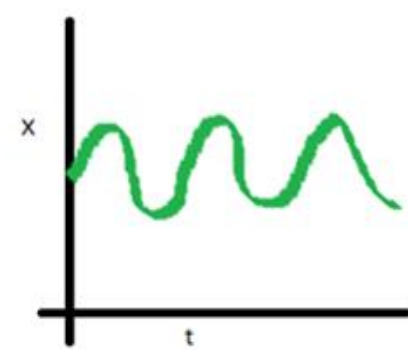
## TIME SERIES STATIONARITY, DETRENDING & DICKEY-FULLER TEST



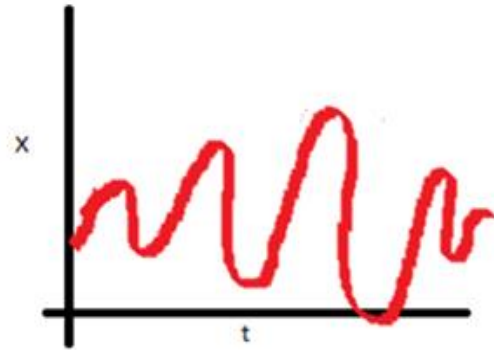
Stationary series



Non-Stationary series

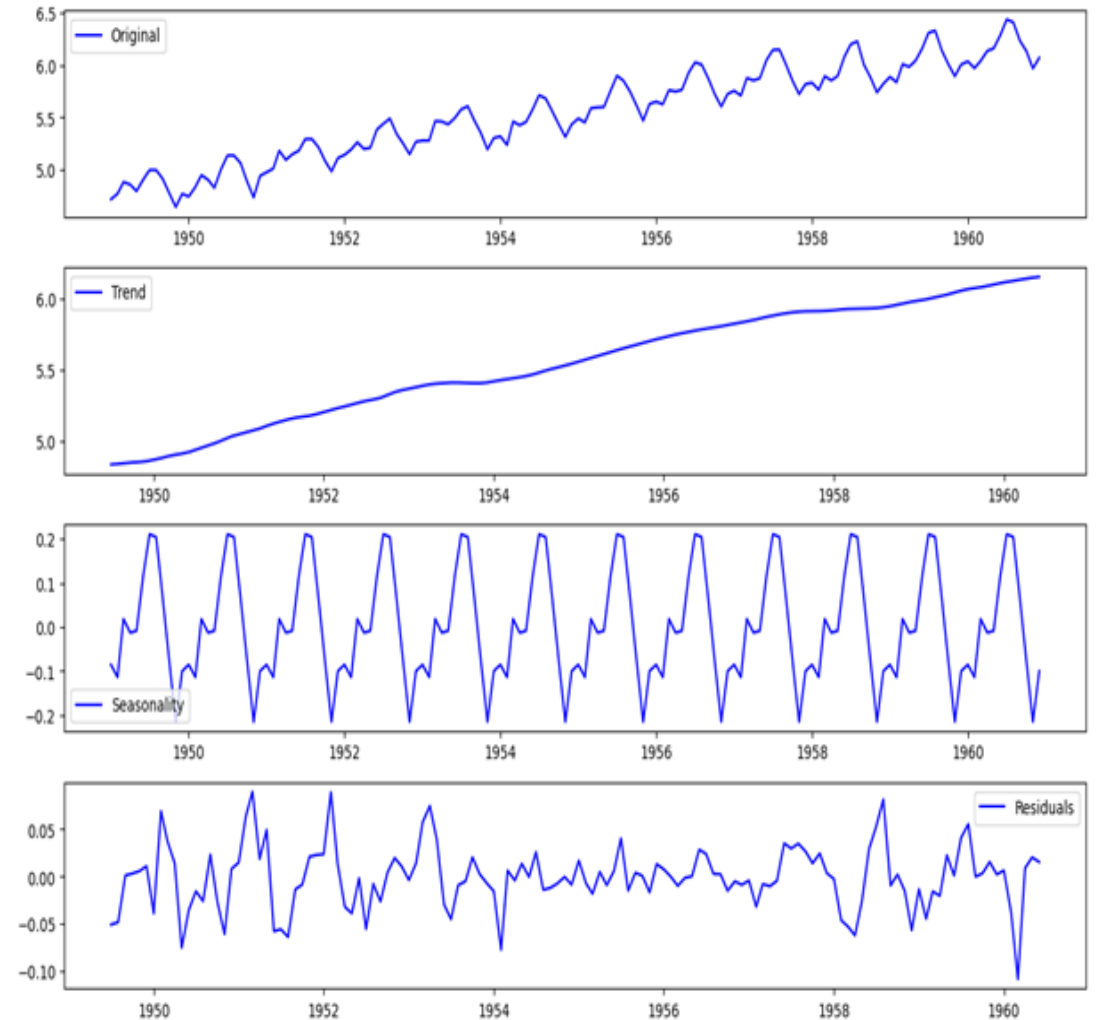


Stationary series



Non-Stationary series

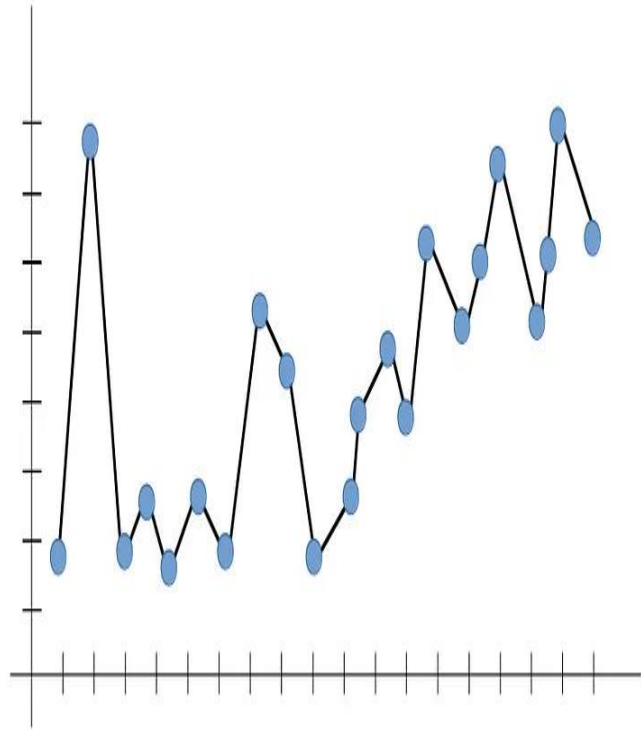
## TIME SERIES DECOMPOSITION



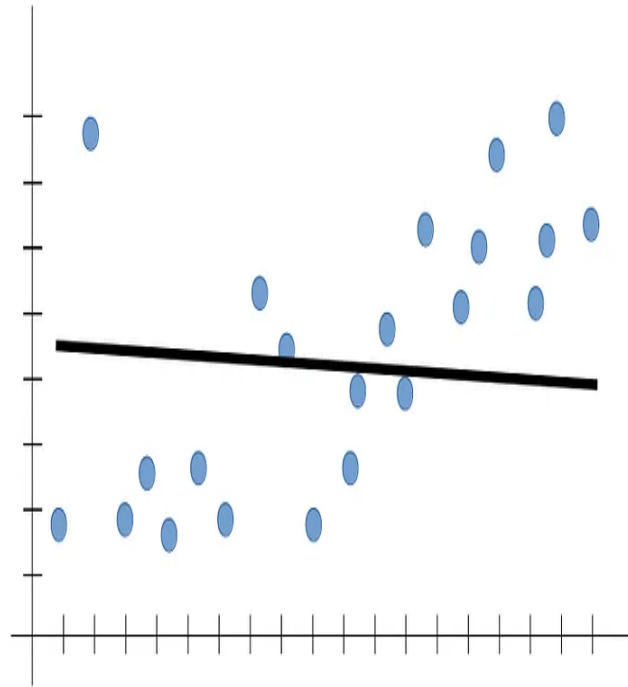
## ....CONT'D

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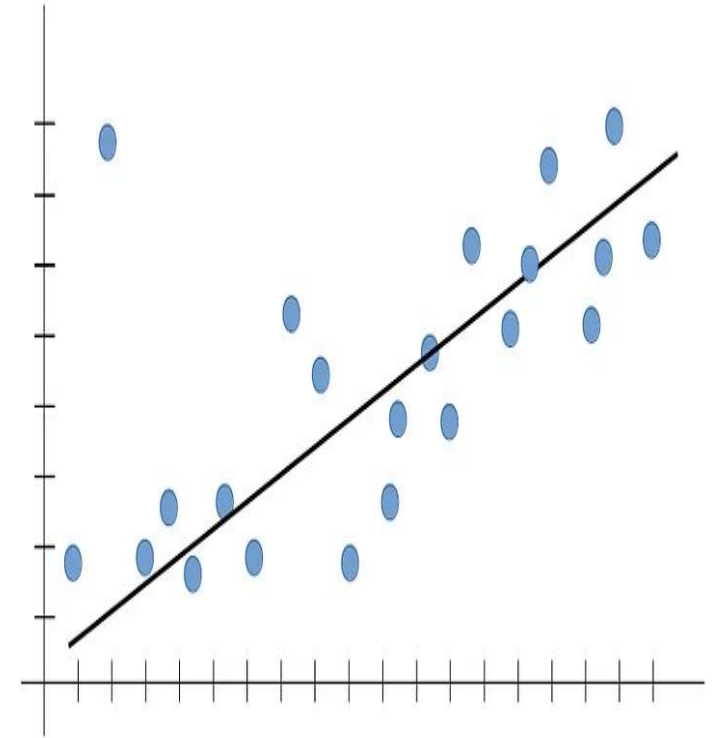
The essence is to capture the dominant trend and fit our line within that trend.



**MODEL OVERFITTING**



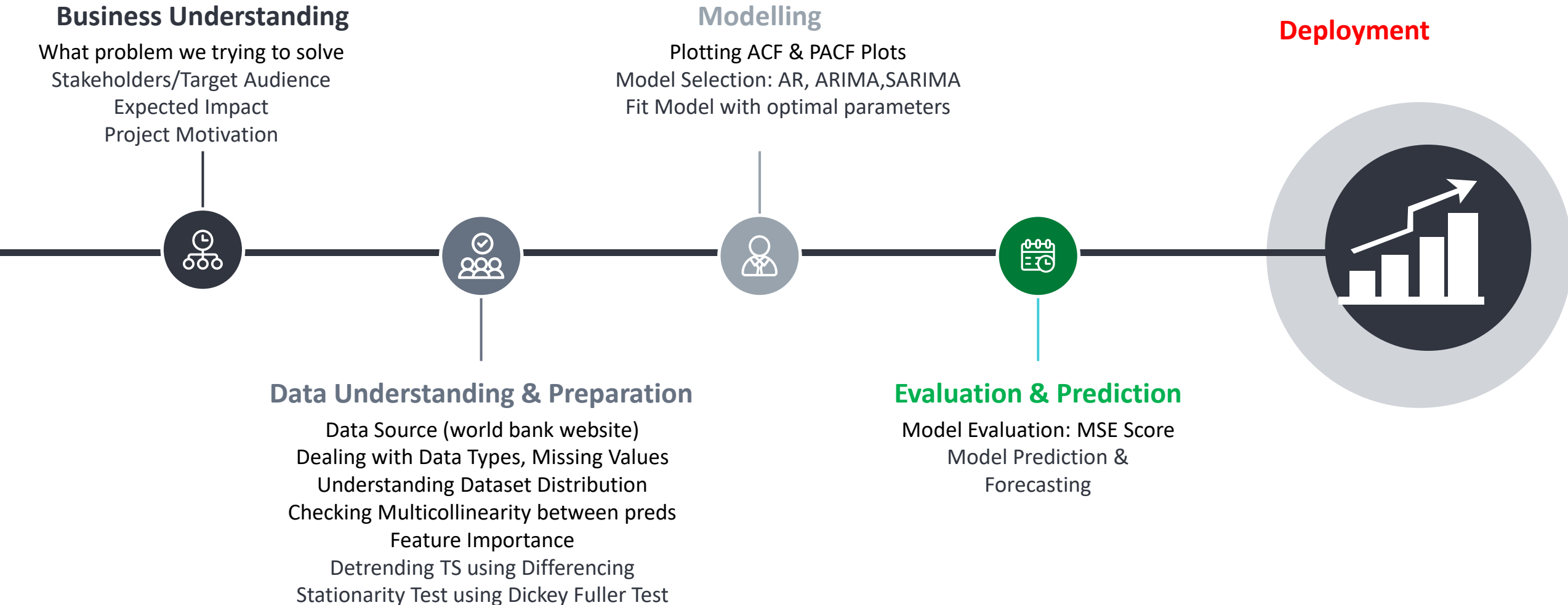
**MODEL UNDERFITTING**



**BEST FIT**

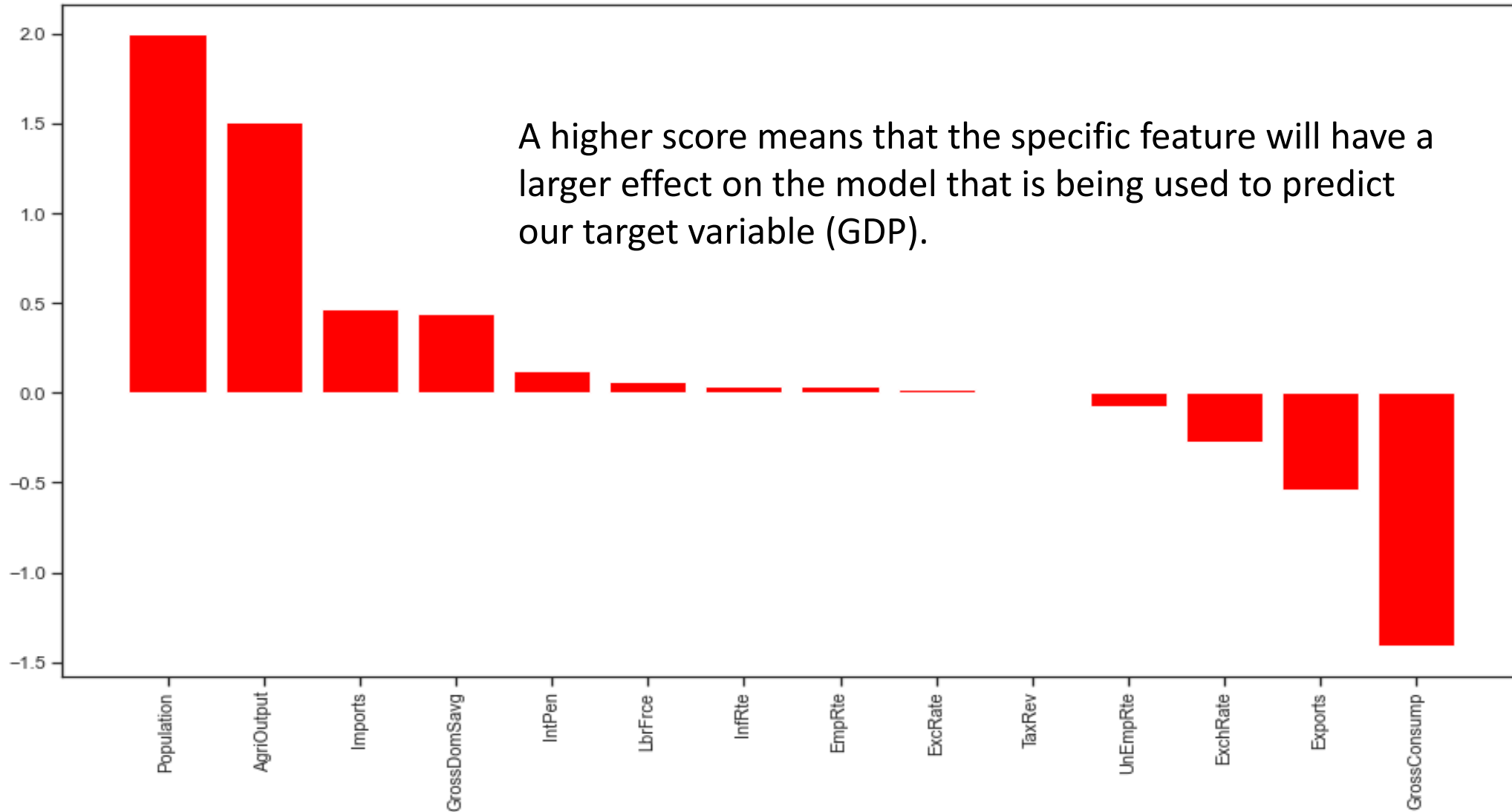
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# PROCESS FLOW (CRISP-DM)



# FEATURE IMPORTANCE

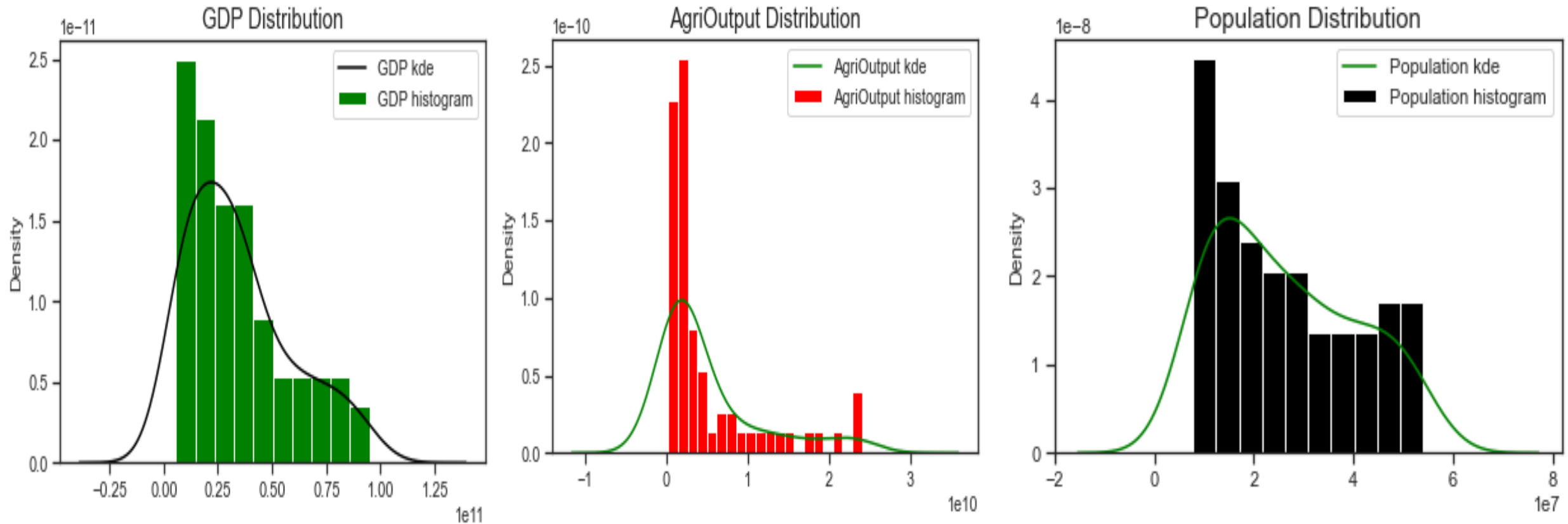
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Scores represent the “importance” of each feature

# LINEARITY

## Visualizing Distributions (Univariate Analysis)

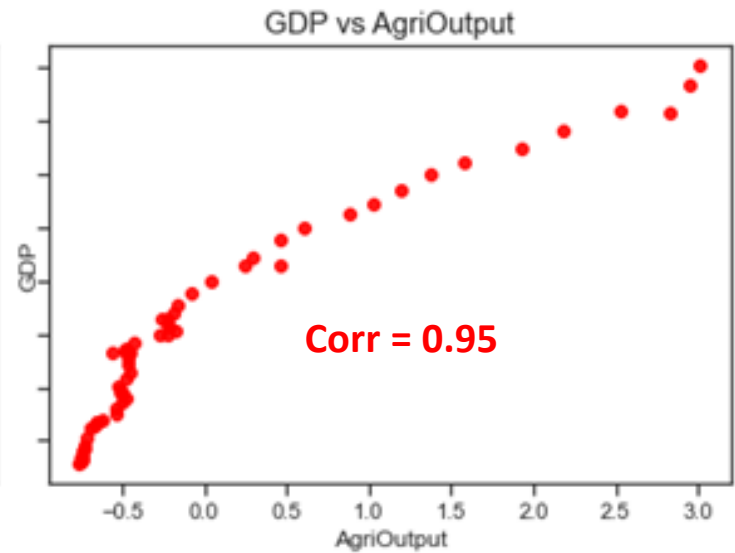
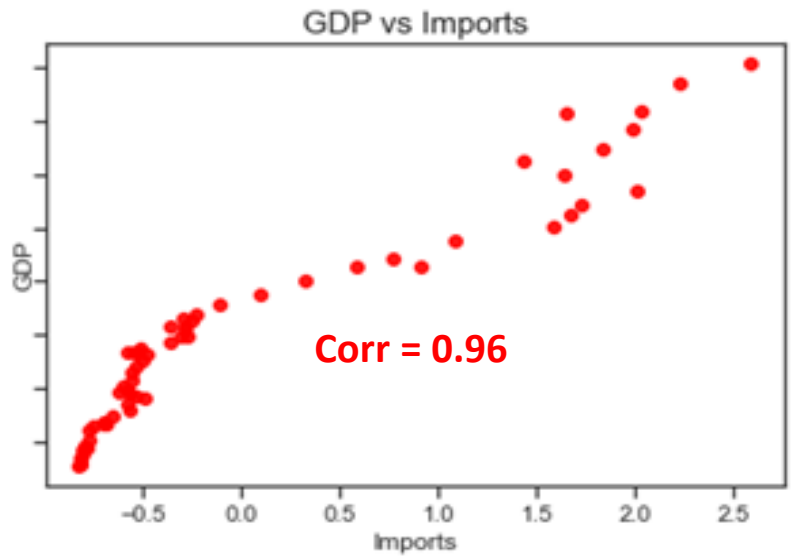
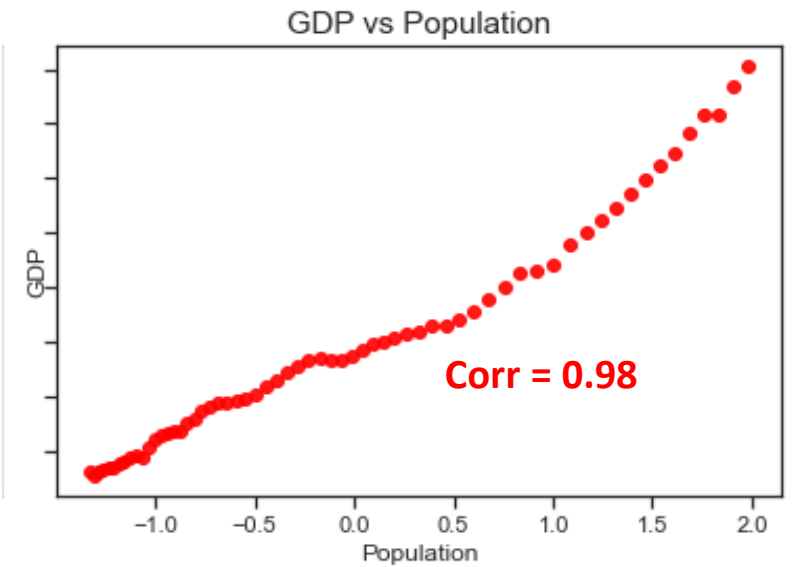


**Variables tend to follow a particular distribution –  
Although Not Perfectly Normal (Positively Skewed).**

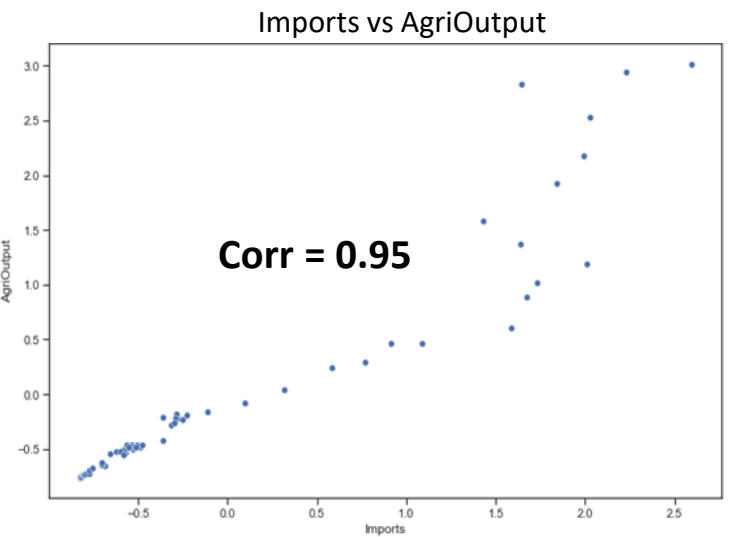
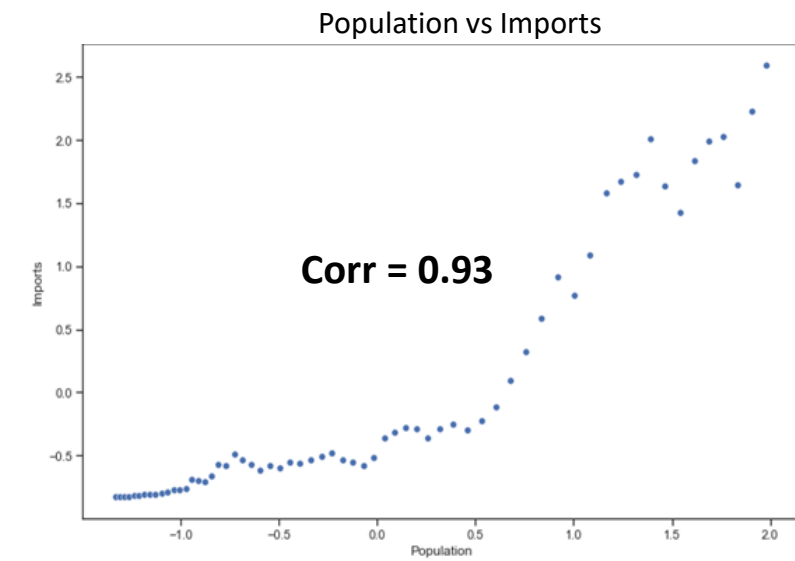
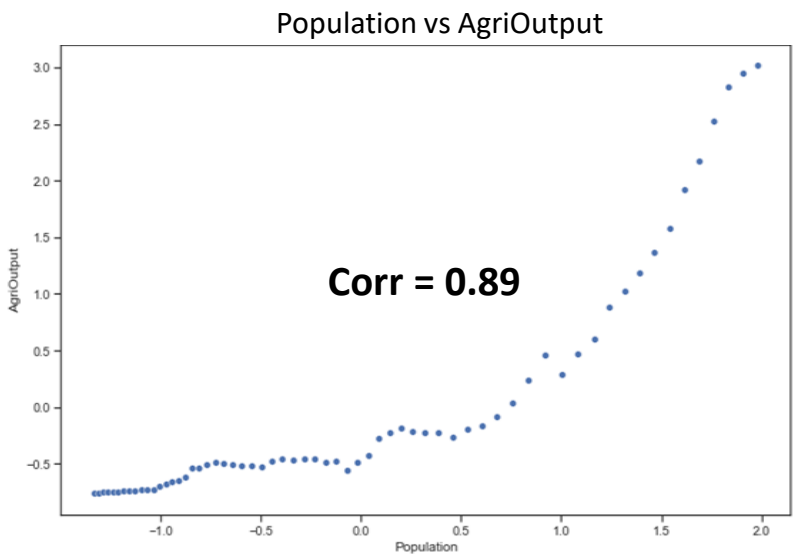


# BIVARIATE ANALYSIS

Variables vs GDP



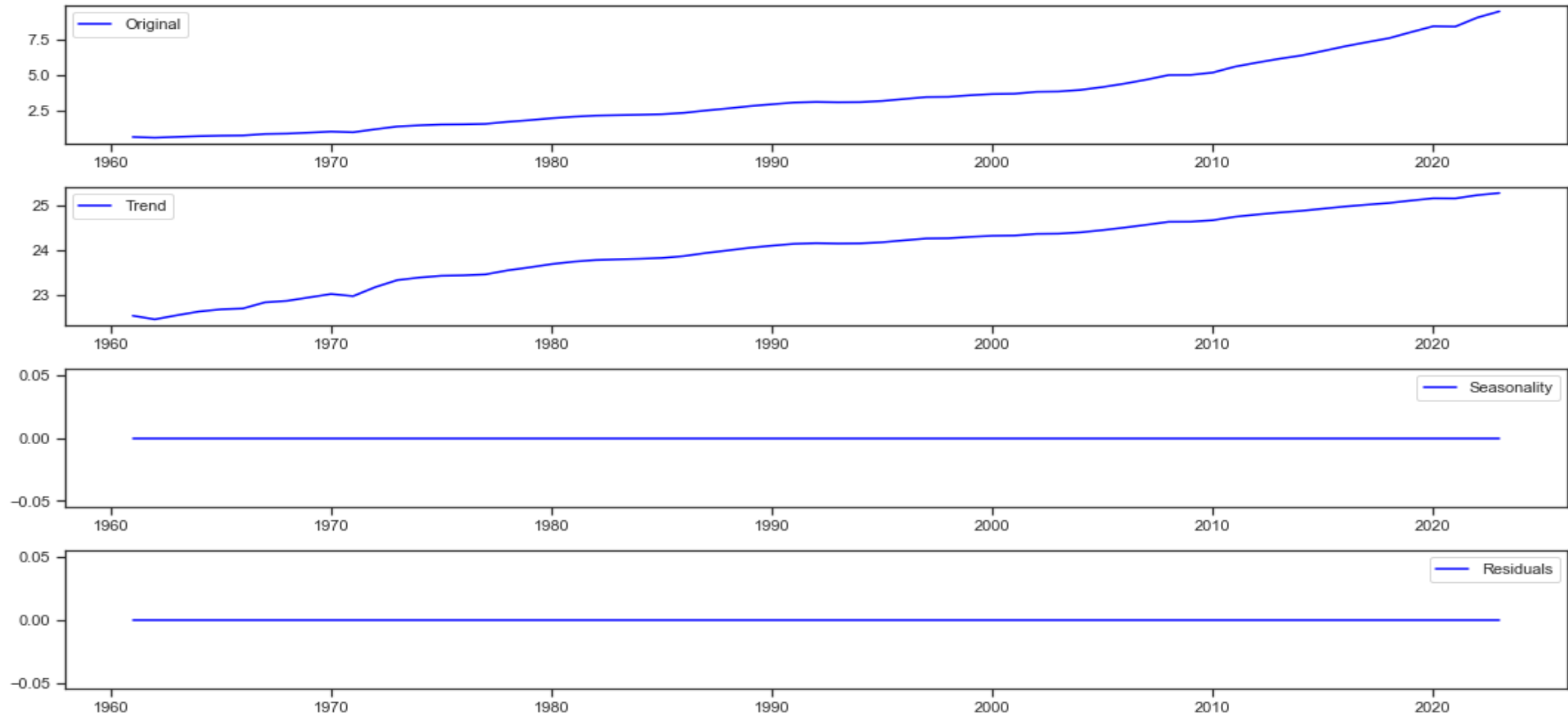
~ Variables



Strong +ve Linear Relationship between Target & Variables

# TIME SERIES (Trends & Seasonality)

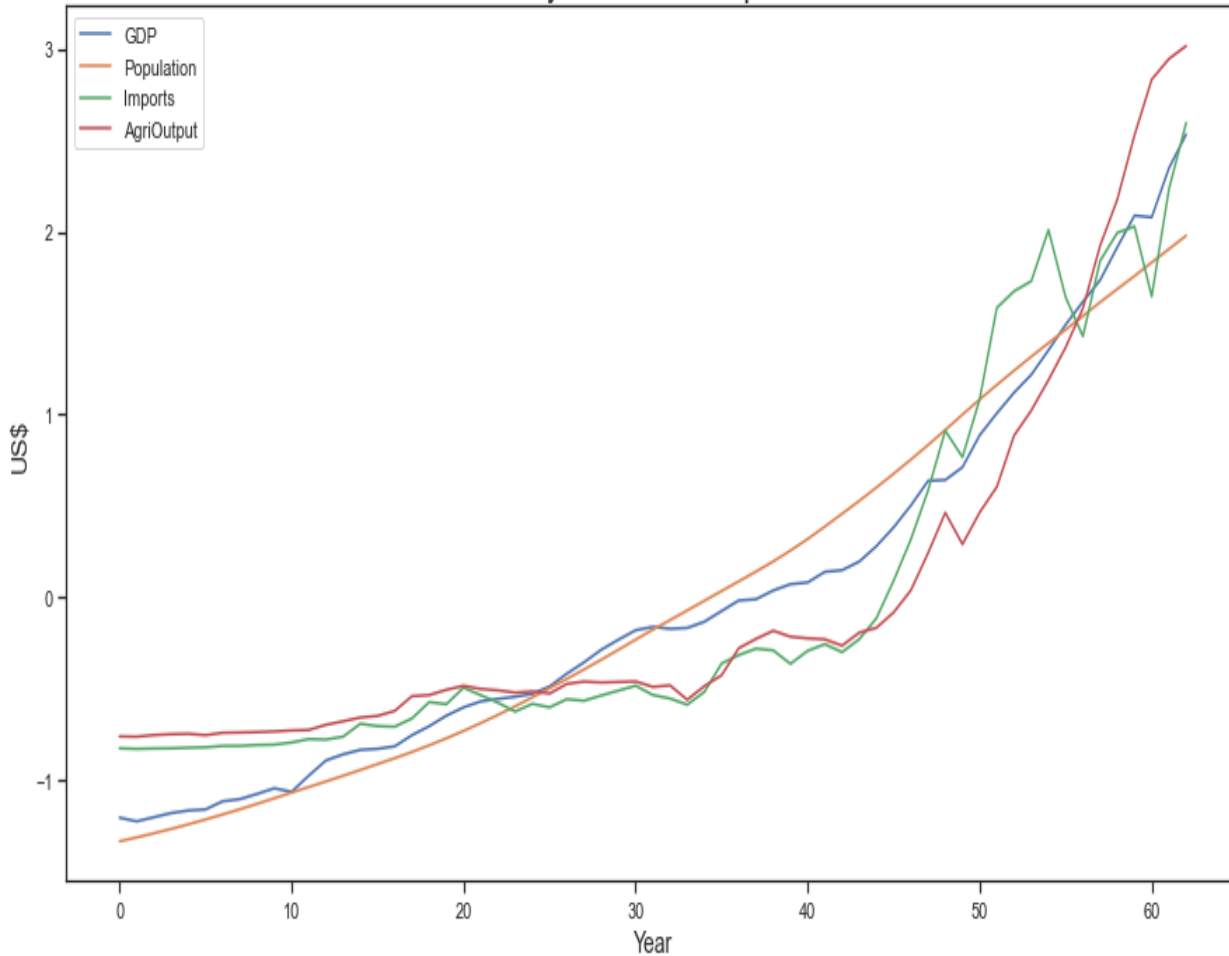
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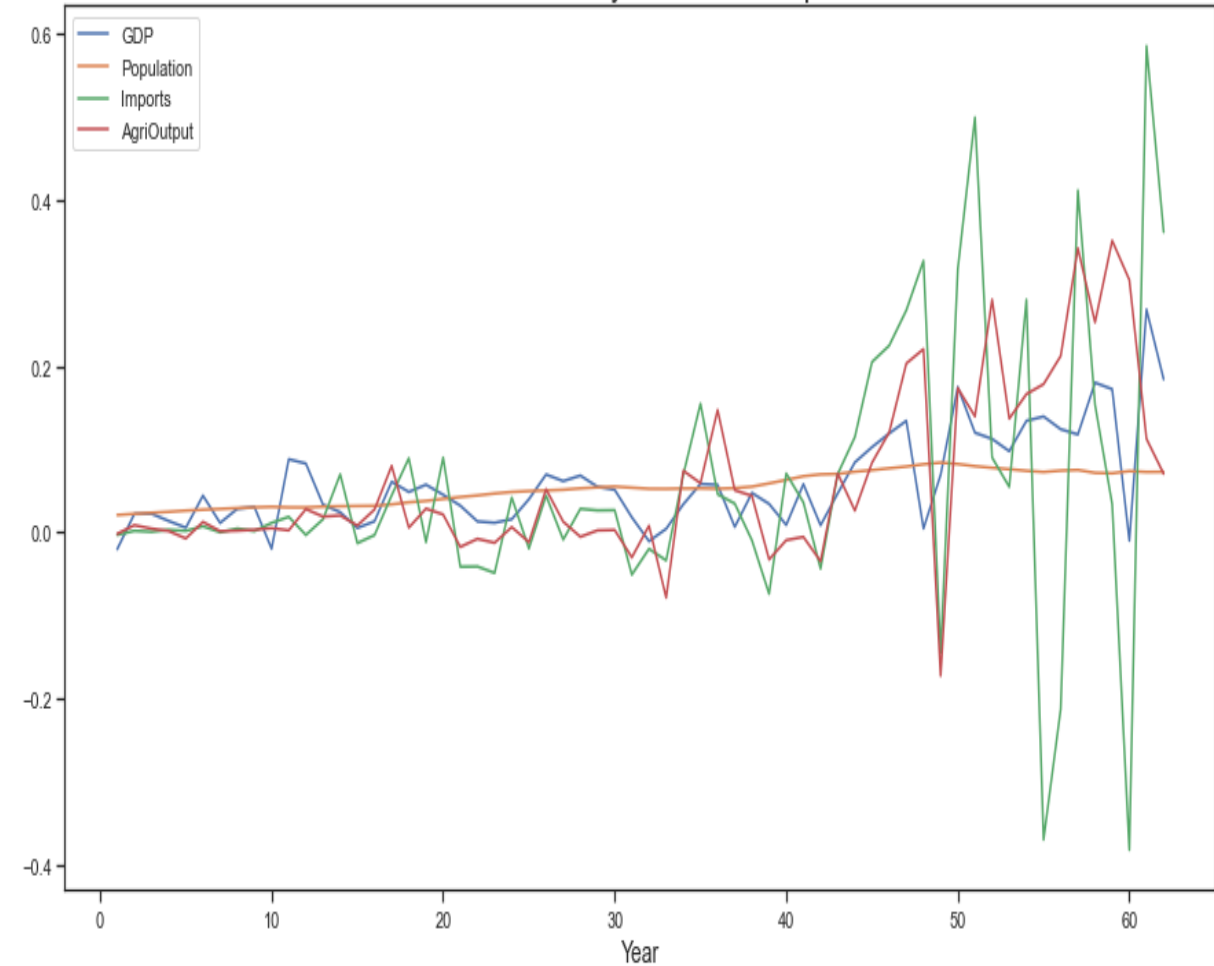
**Decomposed Time Series- No Seasonality**

# TIME SERIES (Stationarity Check)

Trend Analysis: GDP vs Top Predictors



Differenced Trend Analysis: GDP vs Top Predictors

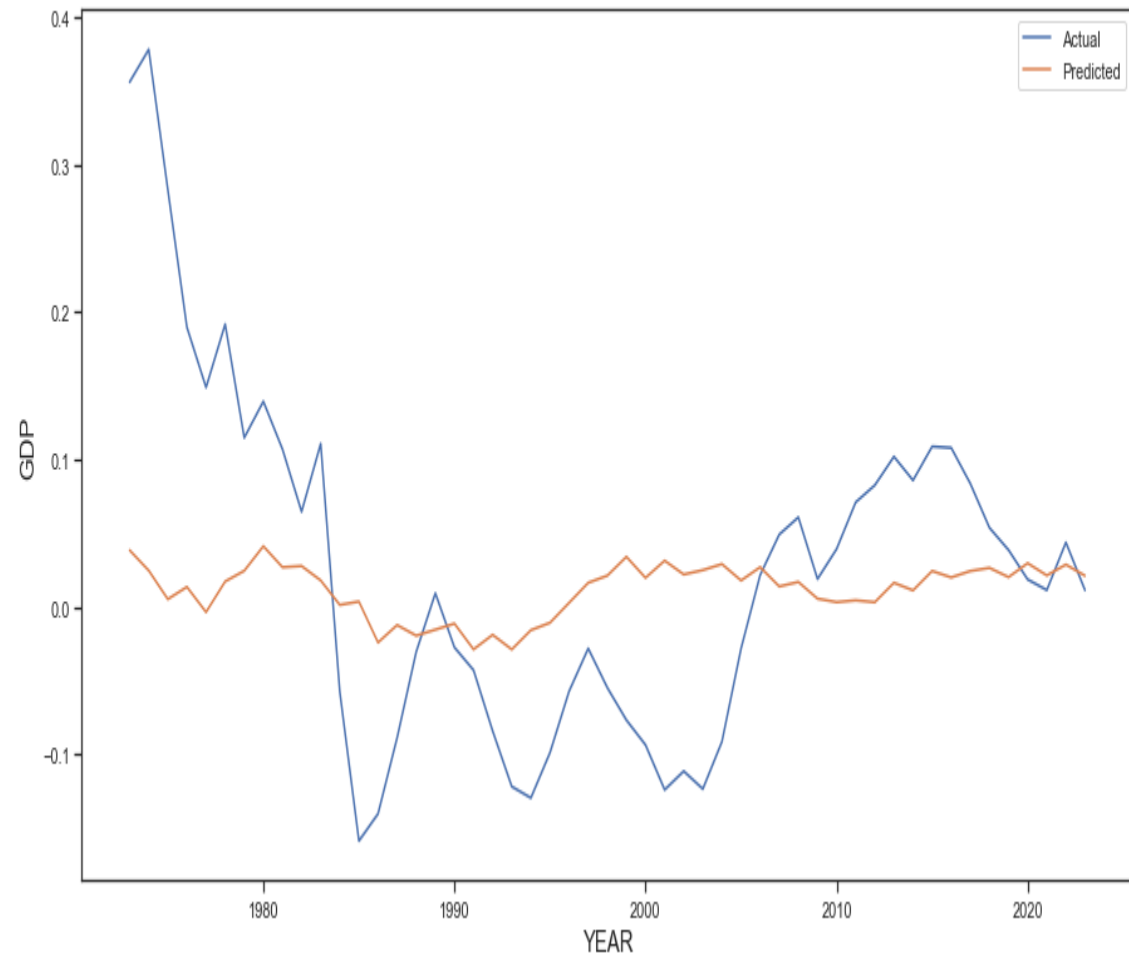


**Differencing done to make our Data Stationary**

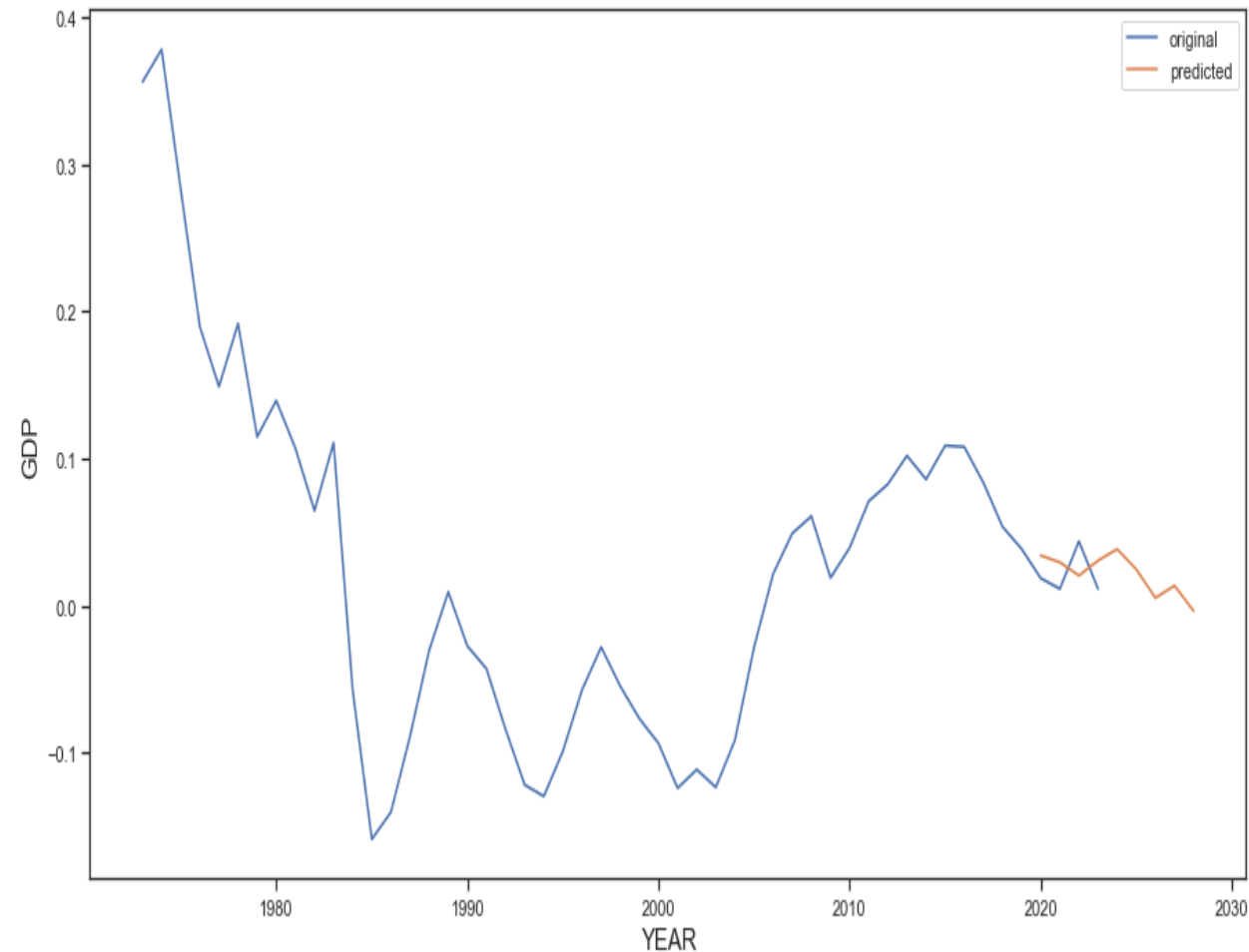
# MODELLING(AR)

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AR Model: Actual vs Predicted



AR Model Forecast Visualization

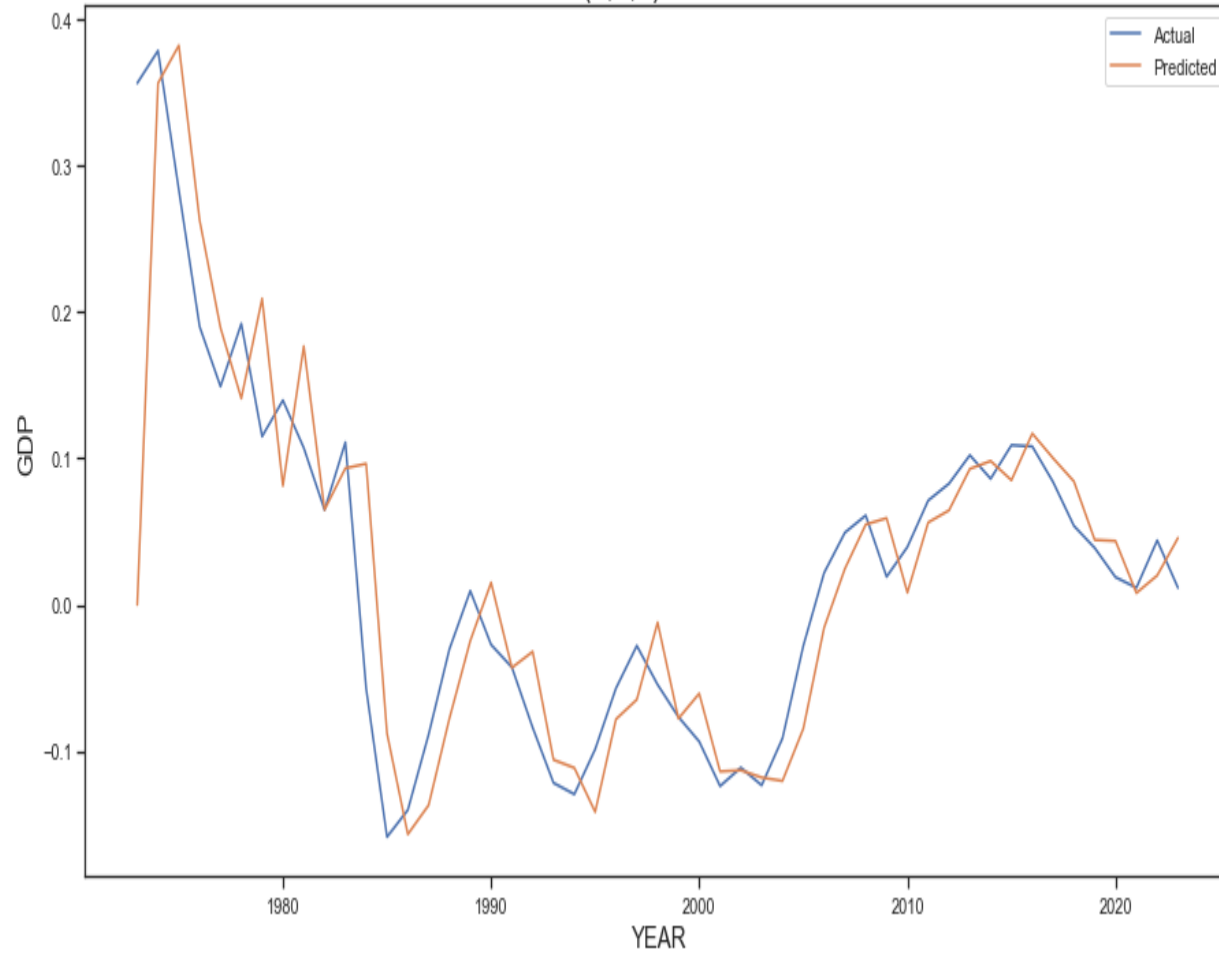


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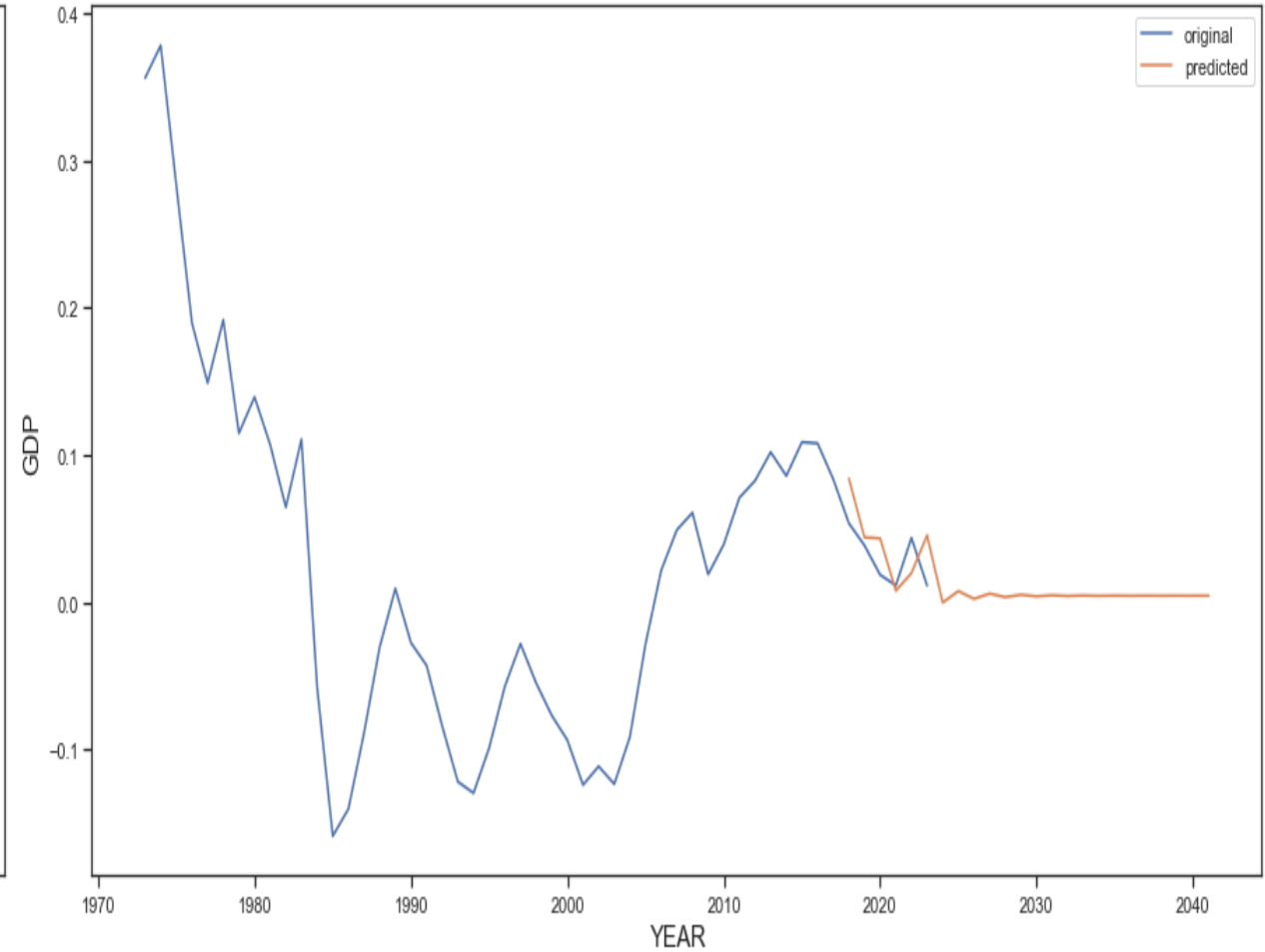
**Auto-Regressive (AR) Model Results**

# MODELLING(ARIMA)

ARIMA Model (1,1,1): Actual vs Predicted



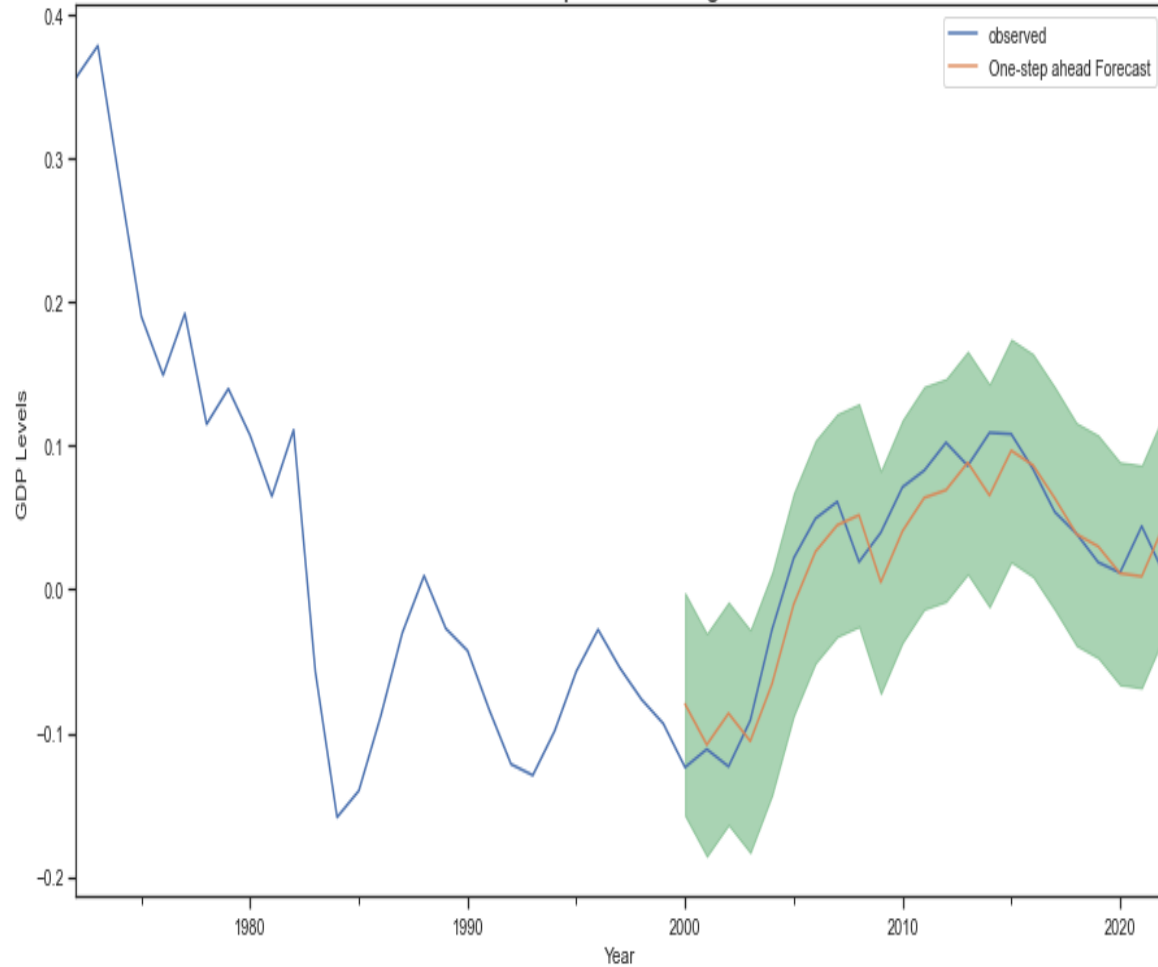
ARIMA Model Forecast Visualization



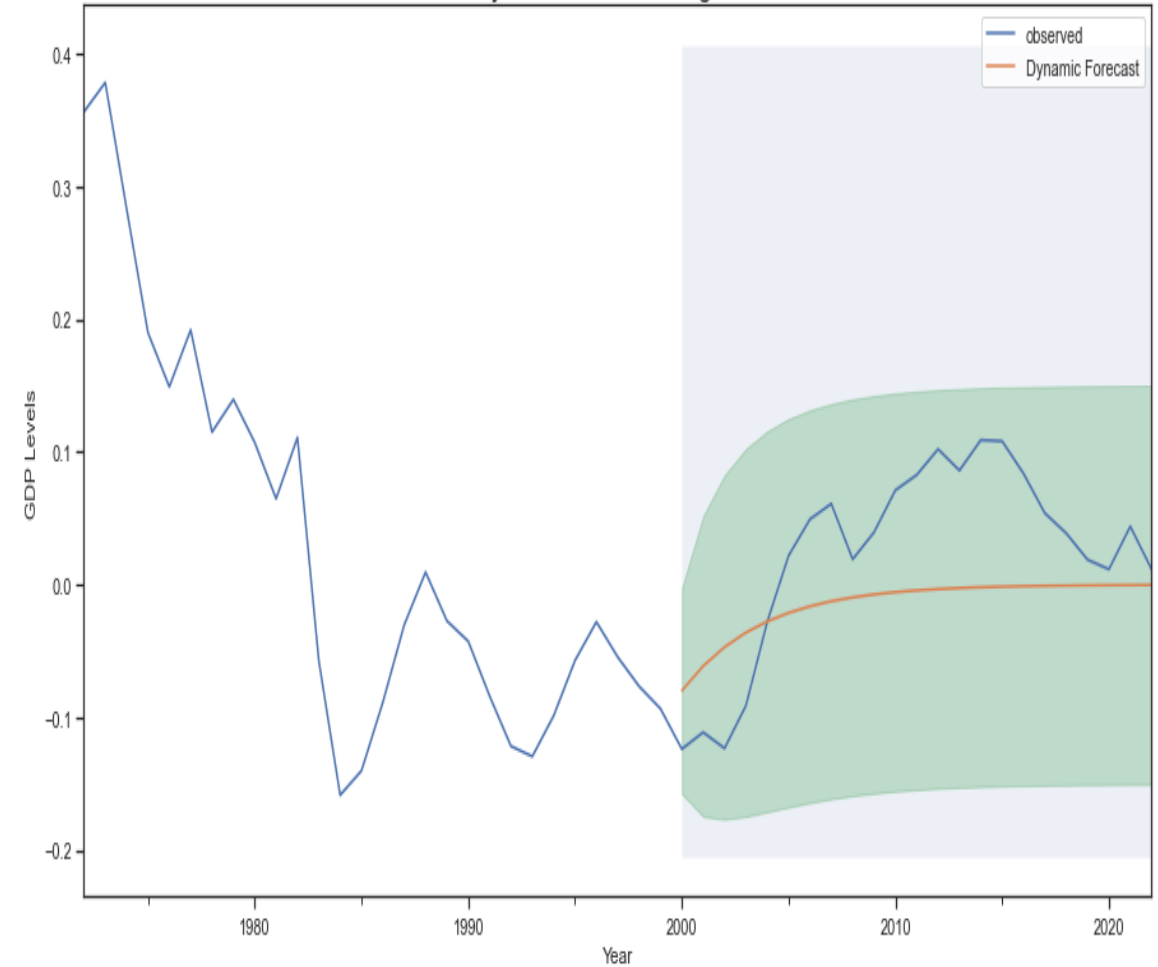
**Model Results**

# MODELLING(SARIMA)

SARIMA Model-One Step Forecasting: Actual vs Predicted



SARIMA Model-Dynamic Forecasting: Actual vs Predicted

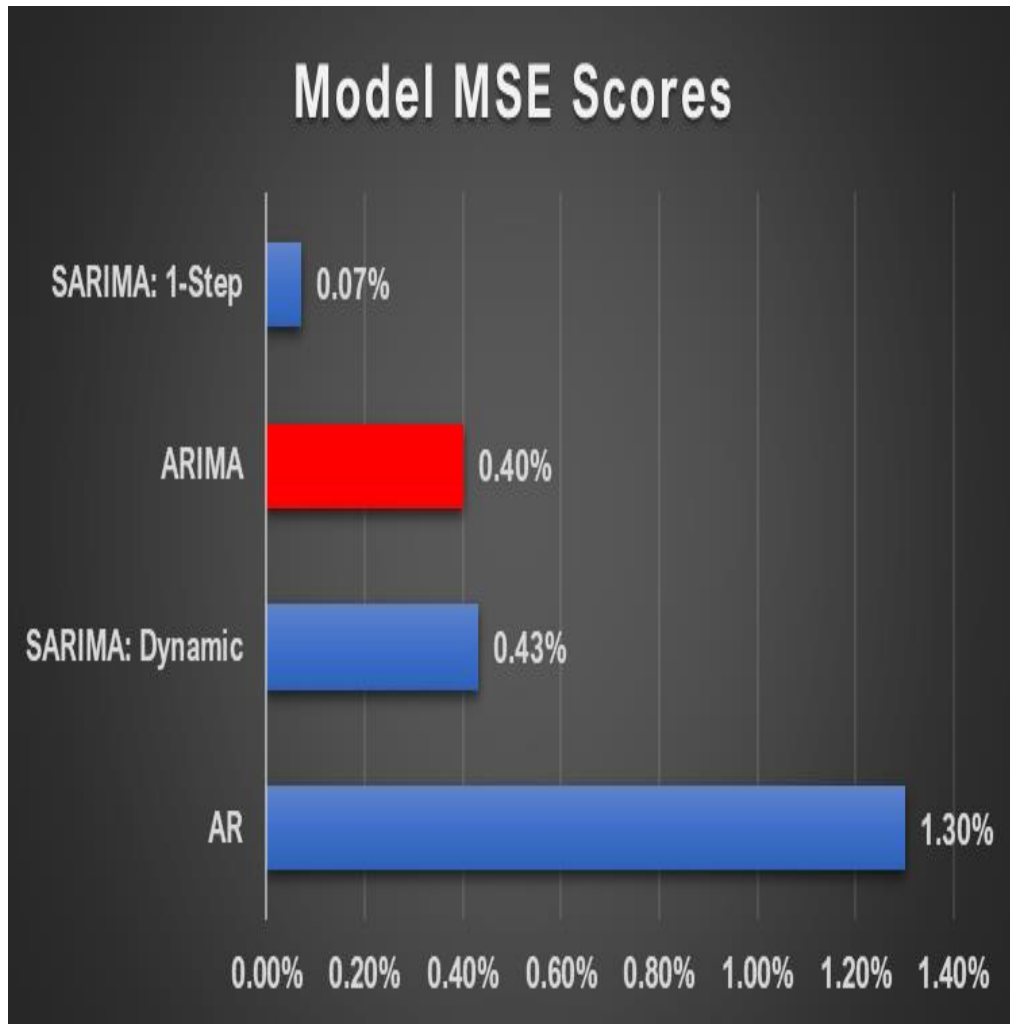


**SARIMA Models Results**



# EVALUATION & SELECTION CRITERION

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## About Mean Squared Error (MSE):

- Checks how close estimates or forecasts are to actual values
- The lower the MSE, the better the model's performance (closer is forecast to actual)
- The MSE of **SARIMA: 1-Step Ahead** forecasts yields a value of close to or equal to zero, which is very low.

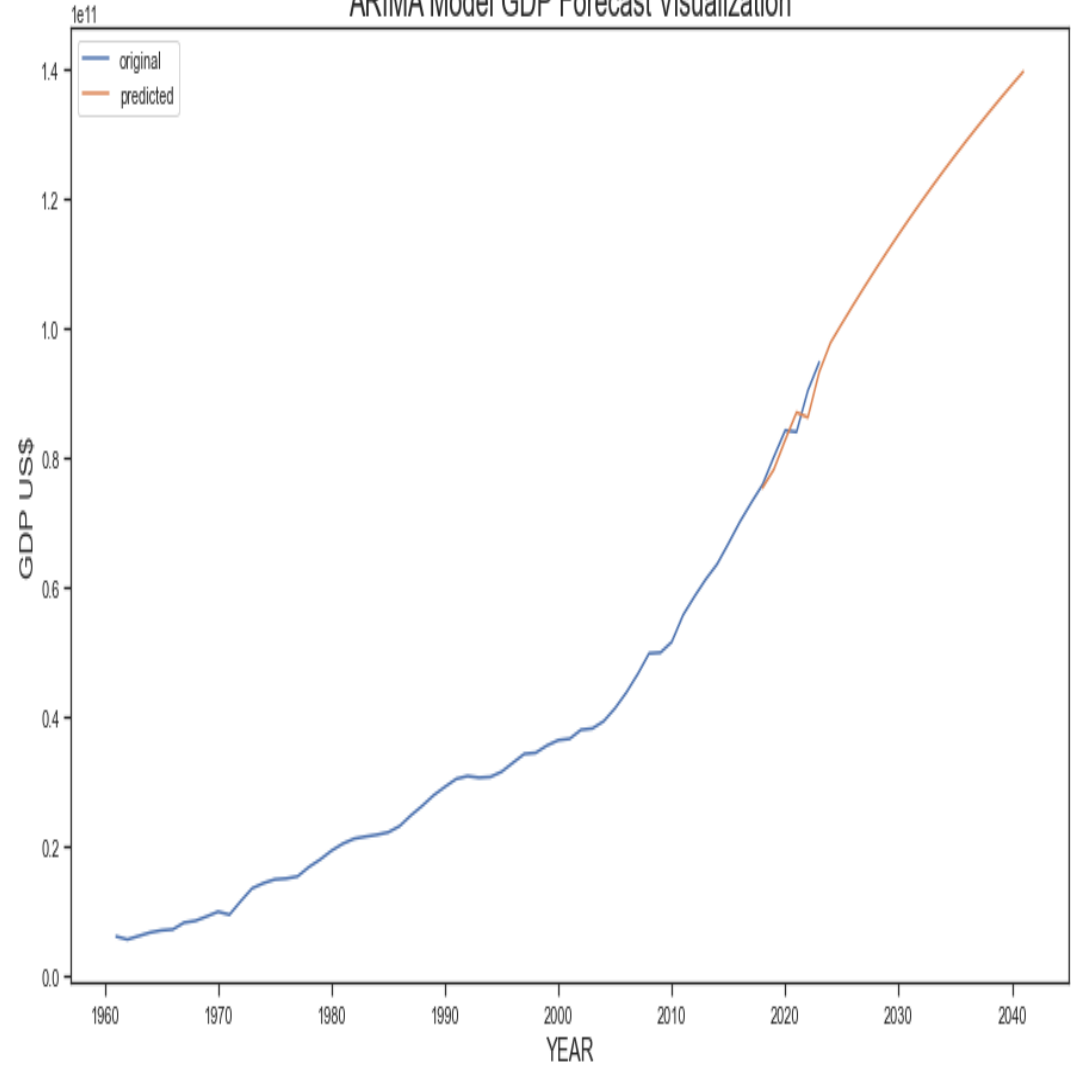
!!!! An MSE that is close to 0 indicates that the estimator is predicting observations of the parameter with perfect accuracy, which would be an ideal scenario, but it is not typically possible.

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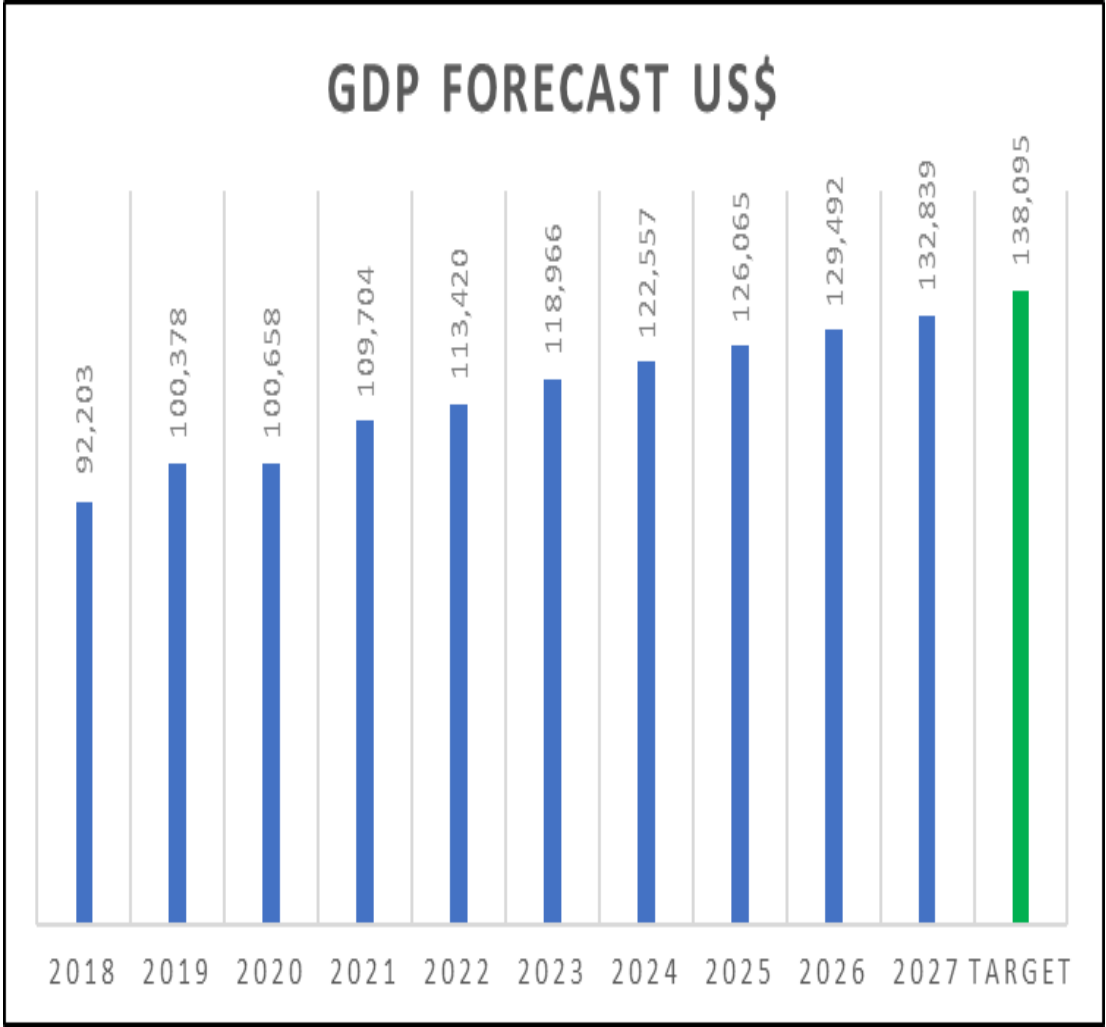
**MODEL SELECTED: ARIMA**

# MODEL DEPLOYMENT

ARIMA Model GDP Forecast Visualization



GDP FORECAST US\$



## DEPLOYMENT RESULTS

# MODEL LIMITATIONS

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- **Missing Data**
- **May Lead To Inaccurate Results In The Long Term (Changing Dynamics / Policies)**
- **Model Deployment (Firewall & Port Restriction)**

# RESULTS & CONCLUSION

## Can Raising Taxes Help the Economy?

1

### Short Term (1-2 years)

**Cutting Taxes:** Boost demand in Economy (Increase Workers Take-Home & Business After-Cash Flows; Increased Hires & Investments/expand activities).

2

### Long Term

**Cutting Taxes:** Induce people to work more; Increase Labor Force; Encourage savings as Firms invest locally (rather than internationally); Encourage creation of new ideas thru research; Slow Economic Growth; Increasing Deficits; Workers might choose to work less due to increased after-tax-income

3

### Difficult to Analyze How Raising Taxes Impact Economy

Policy changes never happen in a vacuum – multiplicity of factors contribute to economic growth or decline, difficult to isolate the effects of raising (or lowering) taxes.

# RECOMMENDATIONS

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1. **Individuals:** Individuals should review their tax withholdings and make sure that they are paying the correct amount of tax. They may also want to consider making changes to their investment portfolios in order to minimize their tax liability.
  2. **Small businesses:** Small businesses should seek professional advice to help them understand the impact of the new taxes on their operations. They may also want to consider joining a trade association or other group that can provide them with support and guidance.
  3. **For the government:** The government should monitor the impact of the new taxes on the economy and make adjustments as needed. They should also be prepared to address any legal challenges to the bill.
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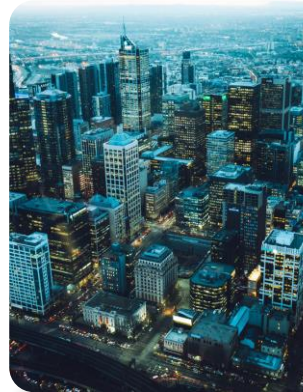
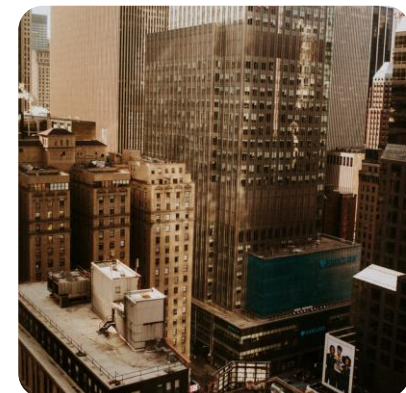
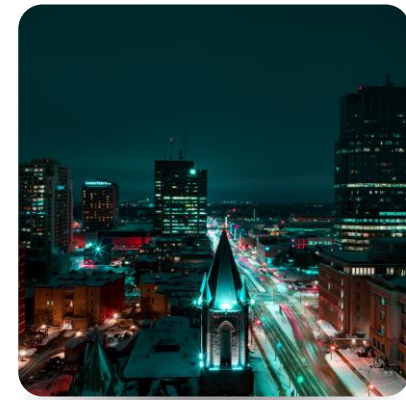


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## Q&A





# TEAM 4

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Kerubo

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Omao

Marvin  
Agumba

Mary  
Murugami

