REPORT OF OUR PROJECT FOR IBMSKILLED INTERNSHIP 2024

Topic: Analysing the Impact of Corruption on Food Security: A Study of the Relationship Between Corruption Index and Global Hunger Index (GHI) (SDG 2: Hunger & SGD: 16: Corruption)

INTRODUCTION

Corruption is a pervasive issue affecting millions of people worldwide, leading to serious socio-economic problems and exacerbating food insecurity. This project, "Analyzing the Impact of Corruption on Food Security," aims to analyze the relationship between corruption and food security by examining data from the Corruption Index and the Global Hunger Index (GHI). According to the 2022 Global Hunger Index, approximately 828 million people worldwide are undernourished. Countries with high levels of corruption often struggle with effective governance and resource allocation, leading to poor outcomes in food security.

By leveraging data analysis tools and methodologies, this project seeks to propose actionable solutions aligned with Sustainable Development Goal 2 (SDG 2): Zero Hunger, and Sustainable Development Goal 16 (SDG 16): Peace, Justice, and Strong Institutions. SDG 2 aims to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. SDG 16 focuses on promoting peaceful and inclusive societies, providing access to justice for all, and building effective, accountable, and inclusive institutions at all levels. The alignment with these SDGs underscores the importance of addressing corruption, which can undermine food distribution systems, leading to inefficiencies and inequities that exacerbate hunger and malnutrition.

The research will utilize data from multiple years (2000, 2007, 2014, and 2022) to identify trends and correlations, providing a comprehensive understanding of how corruption impacts food security over time. By analyzing the correlation between corruption levels and food insecurity, this project aims to provide actionable solutions and policy recommendations to combat corruption and enhance food security, ultimately contributing to the achievement of SDG 2 and SDG 16.

PROBLEM STATEMENT

Food insecurity remains a pressing global issue, affecting millions of individuals and families worldwide. Despite various efforts to combat hunger, the problem persists, particularly in regions plagued by high levels of corruption. Food insecurity is defined as the state in which individuals lack reliable access to sufficient quantities of affordable, nutritious food. This situation can lead to malnutrition, poor health outcomes, and hindered development, particularly in vulnerable populations.

Corruption exacerbates food insecurity by disrupting the effective distribution of resources, increasing the cost of food, and misallocating funds intended for food aid and agricultural development. Corruption can take many forms, including bribery, embezzlement, and favoritism, all of which undermine efforts to ensure food security. When public officials and institutions engage in corrupt practices, resources that should be used to improve food systems and support those in need are often diverted for personal gain. This not only reduces the availability of food but also erodes public trust in institutions, further complicating efforts to address hunger.

Understanding the relationship between corruption levels and food security is critical for developing effective interventions and policies. By identifying how corruption impacts food security, stakeholders can design targeted strategies to mitigate these effects, improve food distribution systems, and enhance transparency and accountability in governance.

OBJECTIVES

The primary objective of this project is to analyze the impact of corruption on food security by examining the relationship between the Corruption Index and the Global Hunger Index (GHI). Specific objectives include:

1. Collecting and analyzing data on corruption and food security from reliable sources.
2. Identifying the correlation between the Corruption Index and the Global Hunger Index (GHI).
3. Understanding temporal and spatial trends of corruption and food insecurity.
4. Developing predictive models for future food security levels based on current data.
5. Proposing actionable solutions and policy recommendations to combat corruption and enhance food security.
6. Assessing the potential impact of these solutions on achieving SDG 2 and SDG 16.

DATA SOURCES

The project will use datasets on corruption and food security from the following sources:

1. Corruption Data: Kaggle
2. Global Hunger Index (GHI): Kaggle

DATA DESCRIPTION

The key features of the dataset will include:

1. Country: This column contains the names or labels of various countries or regions.
2. Corruption Index: A numerical value or index quantifying the level of corruption within each country.
3. Annual Income: Represents average annual income or income per capita for each country.
4. Rank_in_2022: The GHI ranking for each country in 2022.
5. Year_2000, Year_2007, Year_2014, Year_2022: GHI values for specific years.
6. Absolute Change Since 2014, Percent Change Since 2014: Indicate changes in GHI since 2014.

DATA CLEANING AND PREPROCESSING:

1. **Handling Missing Values**: Missing values were identified and handled through imputation or removal, depending on the extent and nature of the missing data. In this dataset, there were no missing values, ensuring a complete dataset for analysis.
2. **Data Merging**: The Corruption Index and GHI datasets were merged based on the country names to form a comprehensive dataset. The merged dataset's shape was (77, 10), indicating a successful combination of both datasets.
3. **Normalization**: Certain columns, such as Annual Income, were normalized to ensure comparability across countries. Normalization ensures that variables with different scales do not disproportionately influence the analysis.
4. **Outlier Detection**: Outliers were detected and treated to prevent skewing the analysis results. By addressing outliers, the analysis becomes more robust and less affected by extreme values.

EXPLORATORY DATA ANALYSIS (EDA)

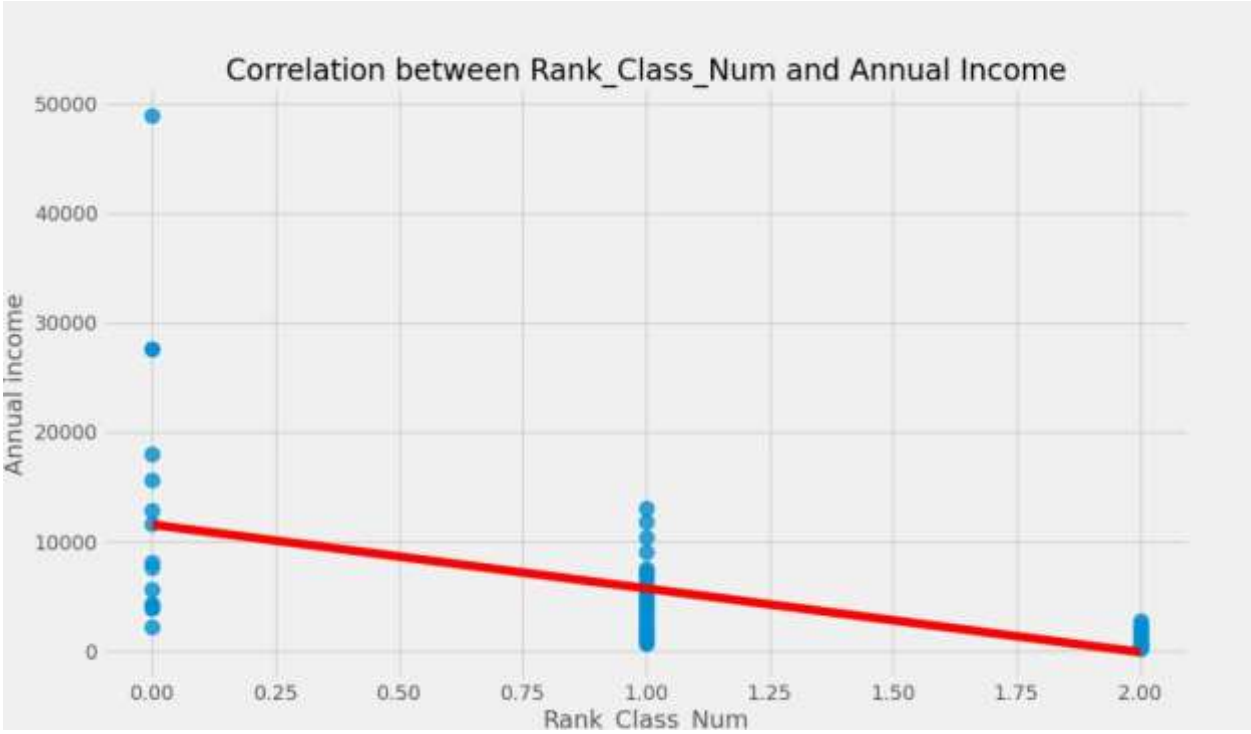
Preliminary analysis suggests a positive correlation between higher corruption levels and higher GHI scores, indicating that countries with higher perceived corruption tend to have more severe food insecurity issues. Specifically, countries with high corruption indices often rank poorly on the Global Hunger Index, demonstrating a significant overlap between governance issues and food security challenges.

In this step, the following operations were performed:

1. **Understanding Your Variables**:
    - Head of the Dataset: Displayed the first few rows to understand the structure and initial values.
    - Shape of the Dataset: Verified the dimensions of the dataset.
    - List Types of All Columns: Checked the data types of each column to ensure proper formatting.
    - Info of the Dataset: Provided a summary of the dataset, including non-null counts and data types.
    - Summary of the Dataset: Offered descriptive statistics to understand the distribution of variables.
2. **Data Cleaning**:
    - Check for Duplicates: Confirmed that there were no duplicate records in the dataset.
    - Check for Missing Values: Ensured that there were no missing values, allowing for a complete analysis.
3. **Feature Selection and Engineering**:
    - Creating New Variables: Calculated the average GHI over the years and created a new variable 'Average_GHI'.
    - Creating Target Variable: Converted the 'Rank_in_2022' variable into a categorical variable ('Rank_Class') with three levels: Low rank (well-nourished countries), Medium rank (moderately nourished countries), and High rank (severely nourished countries). This variable was then numerically encoded as 'Rank_Class_Num'.

Correlation between rank class and annual income

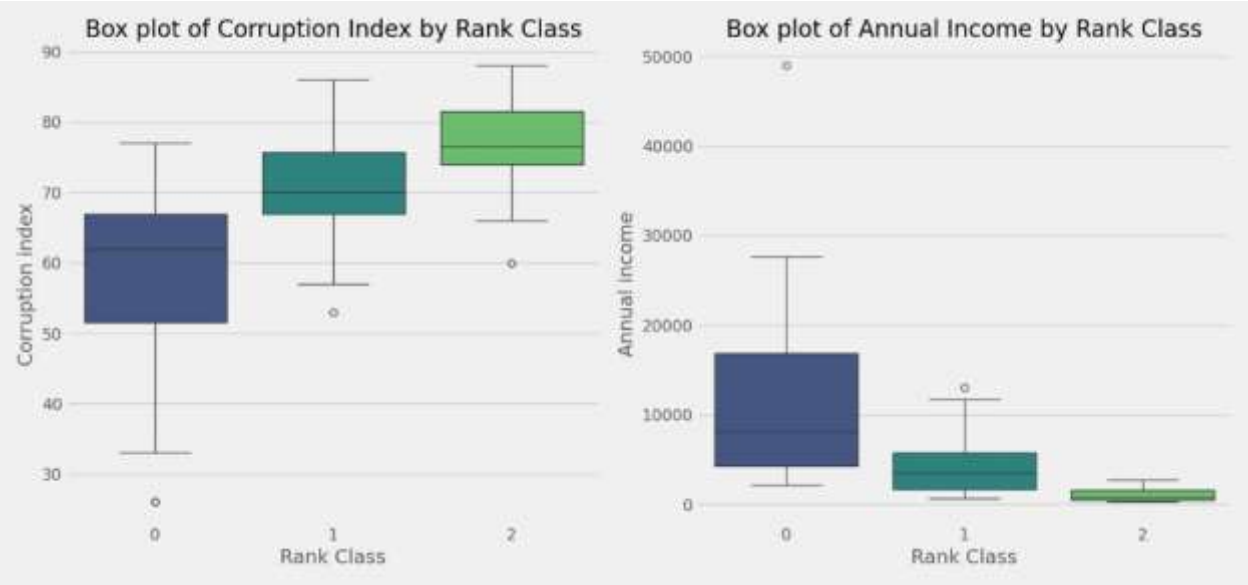
The scatter plot with a regression line shows a negative correlation between the Rank Class and Annual Income. This suggests that as the corruption rank class worsens (higher number), the annual income tends to decrease. This relationship indicates that countries with higher corruption levels tend to have lower annual incomes.



Rank Class Distribution

The pie chart and bar plot illustrate the distribution of countries across different Rank Classes. The largest proportion of countries falls into Rank Class 1 (49.4%), followed by Rank Class 2 (31.2%) and Rank Class 0 (19.5%). This distribution helps us understand the prevalence of different corruption levels across the dataset.

Box Plots of Corruption Index and Annual Income by Rank Class



- The box plots reveal the variability and distribution of the Corruption Index and Annual Income across different Rank Classes:
- The Corruption Index tends to be lower for countries in Rank Class 0 and higher for those in Rank Classes 1 and 2. This indicates that countries with higher corruption are associated with a lower Corruption Index.
- The Annual Income is higher for countries in Rank Class 0 and significantly lower in Rank Classes 1 and 2. This confirms the earlier observation from the scatter plot about the negative correlation between corruption levels and income.

- These visualizations and analyses support the hypothesis that higher corruption levels are associated with greater food insecurity, as indicated by lower annual incomes in countries with higher corruption. The findings suggest that efforts to reduce corruption could potentially improve food security by increasing incomes and enhancing economic stability.
- These visualizations will be incorporated into the report in the respective sections for data analysis and hypothesis testing, providing a visual representation of the findings.

HYPOTHESIS DEVELOPMENT

The central hypothesis of this project posits that:

1. **Higher Levels of Corruption are Significantly Associated with Higher Levels of Food Insecurity**: This hypothesis suggests that as the Corruption Index increases, indicating higher perceived corruption, the Global Hunger Index (GHI) scores also increase, reflecting greater levels of food insecurity. The relationship is expected to be positive, meaning that more corrupt countries experience worse food security conditions.
2. **Addressing Corruption Through Targeted Interventions Can Lead to a Significant Reduction in Food Insecurity Over the Next Decade**: This part of the hypothesis asserts that implementing anti-corruption measures and improving governance can have a substantial impact on reducing food insecurity. It suggests that with effective policies aimed at reducing corruption, countries can see measurable improvements in their GHI scores within a ten-year timeframe.

These hypotheses are grounded in the understanding that corruption undermines effective governance and resource allocation, which are crucial for ensuring food security. By siphoning off resources meant for public services, including food aid and agricultural development, corruption directly impacts the availability and distribution of food, leading to higher rates of hunger and malnutrition.

TESTING THE HYPOTHESIS

To test these hypotheses, the following steps will be undertaken:

1. **Statistical Analysis**: Conduct correlation and regression analyses to quantify the relationship between the Corruption Index and GHI scores. This will help in understanding the strength and direction of the association.
2. **Predictive Modelling**: Develop predictive models using machine learning techniques to forecast GHI scores based on corruption levels and other predictors. Models such as logistic regression, decision trees, and support vector machines will be used to predict the 'Rank_Class' of countries.
3. **Intervention Analysis:** Simulate the impact of potential anti-corruption interventions on GHI scores. This will involve creating scenarios where corruption levels are reduced and observing the corresponding changes in food security metrics.

By combining statistical analysis and predictive modelling, this project aims to provide a comprehensive understanding of how corruption impacts food security and to identify actionable interventions to improve outcomes in line with SDG 2 and SDG 16.

SOLUTION DESIGN

Predictive Modelling:

Predictive modeling will involve using the merged dataset to train machine learning models. The objective is to predict the severity of hunger (Rank_Class) based on the Corruption Index and other variables. The steps involved in predictive modeling include:

1. Data Preparation:
    - Feature engineering to create relevant variables.
    - Splitting the dataset into training and testing sets.
2. Model Selection:
    - Exploring various models such as logistic regression, decision trees, random forests, and support vector machines.
3. Model Training:
    - Training the models using the training dataset.
    - Optimizing model parameters using cross-validation techniques.
4. Model Evaluation:
    - Evaluating the models on the testing set using metrics such as accuracy, precision, recall, and F1-score.
    - Selecting the best-performing model for further analysis.

Model Validation:

- Model validation is crucial to ensure the reliability and generalizability of the predictive models. The steps involved in model validation include:

1. Cross-Validation:
    - Using k-fold cross-validation to assess model performance across different subsets of the data.
2. Performance Metrics:
    - Evaluating the models based on various metrics such as accuracy, precision, recall, F1-score, and ROC-AUC.
3. Testing on Unseen Data:
    - Testing the final model on a hold-out dataset to ensure it performs well on unseen data.

PROPOSED SOLUTIONS:

Based on the analysis, the following interventions are proposed to address the issue of food insecurity exacerbated by corruption:

1. Anti-Corruption Measures: Implementing robust anti-corruption frameworks at both national and local levels can significantly reduce corruption. This includes stricter enforcement of anti-corruption laws, enhancing transparency in government procurement processes, and promoting accountability through independent oversight bodies.
2. Improved Governance: Strengthening governance structures can lead to more efficient allocation of resources, including food distribution. Policies that promote good governance, such as enhancing public sector management and reducing bureaucratic red tape, can improve the delivery of services critical for food security.
3. Better Food Distribution Systems: Developing more efficient and equitable food distribution systems can help mitigate the impact of corruption on food security. This includes creating transparent mechanisms for food aid distribution, investing in infrastructure to reduce post-harvest losses, and supporting local food production systems to ensure a stable food supply.

FEASIBILITY AND IMPACT ASSESSMENT

1. Feasibility: Implementing these solutions requires coordinated efforts from governments, international organizations, and civil society. While the initial costs may be high, the long-term

benefits in terms of reduced corruption and improved food security make these interventions feasible. Capacity-building initiatives and international partnerships can provide the necessary support for these measures.

2. Impact Assessment: The proposed solutions are expected to have a significant impact on achieving SDG 2 (Zero Hunger) and SDG 16 (Peace, Justice, and Strong Institutions). Reducing corruption can lead to better resource allocation, increased economic stability, and improved access to food for vulnerable populations. The success of these interventions can be measured through indicators such as reductions in GHI scores, improvements in governance indices, and increased transparency in government processes.

Overall, addressing corruption through targeted interventions can create a more equitable and secure food system, contributing to global efforts to end hunger and promote just and peaceful societies.

CONCLUSION AND RECOMMENDATIONS

The analysis reveals a significant correlation between corruption levels and food insecurity across various countries. Key findings include:

1. Correlation between Corruption and Food Insecurity: Higher corruption indices are associated with higher Global Hunger Index (GHI) scores, indicating greater food insecurity in more corrupt countries.
2. Economic Impact: Countries with lower annual incomes tend to have higher corruption indices, suggesting that economic conditions and corruption are intertwined, further impacting food security.
3. Global Patterns: The distribution of corruption and food insecurity is not uniform, with certain regions exhibiting particularly high levels of both, underscoring the need for targeted interventions.

POLICY RECOMMENDATIONS:

Based on the findings, several policy recommendations can be made to address the issue of food insecurity exacerbated by corruption:

1. Strengthen Anti-Corruption Measures: Implementing robust anti-corruption frameworks and enhancing transparency in governance can reduce corruption's impact on food security. This includes stringent enforcement of anti-corruption laws, increasing the transparency of government spending, and promoting a culture of accountability.
2. Enhance Governance and Institutional Capacity: Improving the effectiveness and efficiency of public institutions, especially those involved in food distribution and agricultural development, can mitigate the adverse effects of corruption. This includes capacity-building initiatives, better resource management, and fostering public participation in decision-making processes.
3. Economic and Social Policies: Developing economic policies that support income growth and equitable distribution can reduce the economic disparities that often accompany high corruption levels. Social safety nets and food assistance programs can provide immediate relief to those most affected by food insecurity.
4. International Cooperation and Support: Global partnerships and international aid can play a critical role in supporting anti-corruption efforts and food security initiatives in developing countries. This includes financial assistance, technology transfer, and capacity-building support.

By implementing these recommendations, countries can make significant progress in reducing both corruption and food insecurity, thereby achieving key targets of SDG 2 and SDG 16.

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