# Project Report

## Introduction

People from different walks of life are attracted to different professions for various reasons. Some do what they do for passion and purpose, others for psychological and emotional needs, and many for financial prosperity and security. While a conversation around what objectively is the most beneficial path when considering a profession might be helpful, it almost always leads to contrasting points of view. Reflecting on one's own experience, one can notice the persistent issue observed worldwide in the lack of understanding of economics and financial literacy. The motivation for our project aims to address the underlying topic usually present during discussions around these topics. The main point of the topic is poverty! What are the main drivers behind poverty? What causes poverty to increase, and how to prevent it? Because to address wealth, the lack of poverty, one must first address the reasons poverty comes about. Most topics around poverty tend to address poverty from a national or global perspective. Our research aims to gather data utilized by the same entities that tackle issues of poverty on a global level and synthesize valuable patterns that can help the individual be aware of the drivers behind poverty on an individual level.

## Background

Our project started with gathering information around the dedicated entities that gather and analyze global information related to economics, the standard of living, and other financial-related topics of interest. We aimed to understand their roles to identify the single subject matter expert concerning poverty and wealth. The World Bank (TWB) currently designates this role. We proceeded to understand how TWB measured and calculated the Key Point Indicators (KPIs) used to analyze and assess the economic mechanisms behind poverty and wealth while focusing on poverty. However, the amount of available data was large and intimidating. Accordingly, we filtered through the available data to identify the indices best fit for our experiment and continued to ensure a consistent amount of data was available for a random selection of countries. Furthermore, we needed to avoid data from periods of extreme economic situations, usually driven by market collapse, pandemics, or war. Given our set conditions, we let the availability of the data direct the process for random selection of the countries.

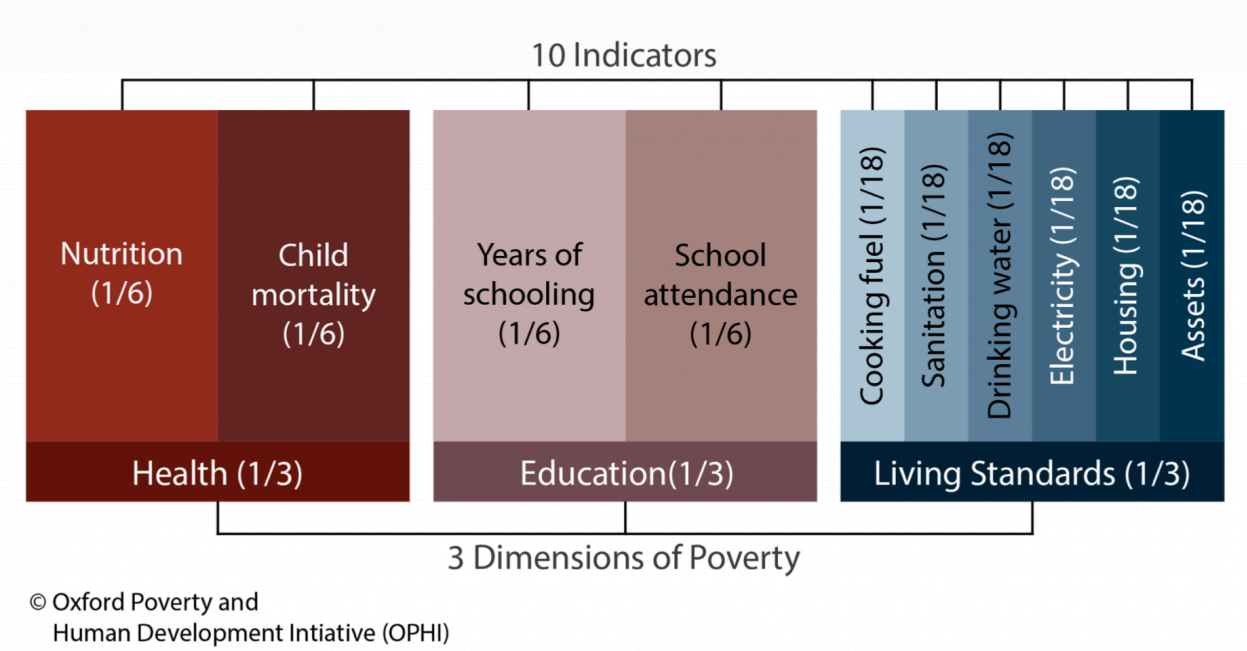
## Model

Based on the research we were conducting, it was clear that we needed to use a model based on Multi-Linear Regression (MLR). MLR is a statistical technique that uses several explanatory variables (i.e., Predictors) to predict a response variable's outcome. Therefore, we utilized the data we collected by building uniform datasets consisting of a single response and four predictors, with each data frame consisting of six rows made of biannual-means and 17 columns representing 17 different countries.

Michael Ghattas
Chan Kim

The final 17 countries were Bangladesh, the Democratic Republic of Congo, Dominican Republic, Jordan, Lesotho, Malawi, Mongolia, Morocco, Nigeria, Peru, Philippines, Senegal, Sierra Leone, South Africa, Suriname, Togo, and Zimbabwe.

We chose the global Multidimensional Poverty Index (MPI), which measures international MPI, for our response. MPI was an excellent choice for us because it complemented the traditional monetary poverty measures by capturing the destitution in health, education, and living standards that a person faces.



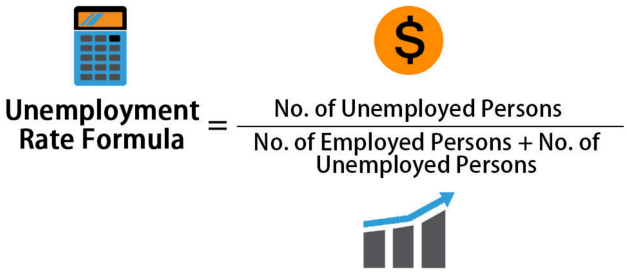


Our first predictor was the Gross Domestic Product (GDP) per capita, which calculates a country's GDP divided by its total population. GDP measures a country's economic output through business investment, net exports of goods and services, government spending, and individual consumption expenditures. GDP per capita accounts for the number of people in the economy in relation to its GDP.

Our second predictor was Purchasing power parity (PPP), which measures different countries' currencies through the "basket of goods" approach, determining the exchange rate between currencies for trade to be on par with the purchasing power of the countries' currencies. PPP allows us to compare countries' economic productivity and living standards.


Our third predictor was The consumer price index (CPI), which measures changes over time in the level of prices of goods and services paid for by the general public for consumption. CPI is constructed as a weighted average of many elementary aggregate indices and is the KPI for measuring inflation in an economy.

Our fourth and final predictor was the Unemployment rate (UEM), which measures the labor force ratio that is jobless against the total available workforce. UEM generally rises or falls to changing economic conditions rather than anticipating them. Accordingly, UEM also measures the underutilization of the labor force, reflecting the inability of an economy to generate employment for those willing to work but are unable to.




## Methods

Utilizing our MLR model, from 17 countries we tested our model on, 12 displayed good fit characteristics denoted by an R^2 value greater than 0.7. R-Squared (R^2), measures the proportion of the variance for a dependent variable explained by an independent variable or variables in a regression model. While we had observed 12 successful fits for our model, only four tests generated an overall p-value below 0.05 and above 0. The p-value tests the null hypothesis through the coefficient being equal to zero. A low p-value (< 0.05) indicates that you can reject the null hypothesis. While contrarily, a larger (insignificant) p-value suggests that changes in the predictor are not associated with changes in the response. We could not identify why such disparity was present between the results of 17 tests concerning the model fit and significance level. Accordingly, to better understand the results of our analysis, we conducted an Analysis of Variance (ANOVA) test on each of the 17 models. ANOVA consisted of calculations that provide information about levels of variability within each MLR model, thus forming a basis for significance tests. Furthermore, we considered attempting other possible techniques to look for possible correlations, such as Generalized Least Squares (GLS), a technique for estimating the unknown parameters in a linear regression model when there is a certain degree of correlation between the residuals in a regression model. However, we deemed it unnecessary given our number of samples, the respective number of predictors, and test results. We have attached below a brief snapshot of some of the results to highlight our methods and analysis.

```
Zimbabwe <- data.frame(UEM$Zimbabwe, MPI$Zimbabwe, CPI$Zimbabwe, GDP$Zimbabwe, PPP$Zimbabwe)
Lmod_Zimbabwe = lm(MPI.Zimbabwe ~ ., data = Zimbabwe)
summary(Lmod_Zimbabwe)

anova_Zimbabwe = aov(Lmod_Zimbabwe)
summary(anova_Zimbabwe)
```

```
Call:
lm(formula = MPI.Zimbabwe ~ ., data = Zimbabwe)

Residuals:
        1         2         3         4         5         6
-0.000143  0.001711  0.004362 -0.005897  0.001147 -0.001181

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -9.029e-16  3.148e-03    0.00  1.00000
UEM.Zimbabwe -5.597e-01  4.144e-03 -135.06  0.00471 **
CPI.Zimbabwe  1.132e+00  9.255e-03  122.29  0.00521 **
GDP.Zimbabwe  6.290e-02  5.926e-03   10.61  0.05981 .
PPP.Zimbabwe -1.365e+00  8.088e-03 -168.81  0.00377 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.007711 on 1 degrees of freedom
Multiple R-squared:      1,     Adjusted R-squared:  0.9999
F-statistic: 2.102e+04 on 4 and 1 DF,  p-value: 0.005173
             Df Sum Sq Mean Sq F value  Pr(>F)
UEM.Zimbabwe  1 1.7879  1.7879 30070.0 0.00367 **
CPI.Zimbabwe  1 0.0093  0.0093   156.1 0.05085 .
GDP.Zimbabwe  1 1.5805  1.5805 25371.8 0.00400 **
PPP.Zimbabwe  1 1.6942  1.6942 28495.1 0.00377 **
Residuals     1 0.0001  0.0001
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Nigeria <- data.frame(UEM$Nigeria, MPI$Nigeria, CPI$Nigeria, GDP$Nigeria, PPP$Nigeria)
Lmod_Nigeria = lm(MPI.Nigeria ~ ., data = Nigeria)
summary(Lmod_Nigeria)

anova_Nigeria = aov(Lmod_Nigeria)
summary(anova_Nigeria)
```

```
Call:
lm(formula = MPI.Nigeria ~ ., data = Nigeria)

Residuals:
       1        2        3        4        5        6
 0.02209 -0.00307 -0.01378 -0.01608 -0.03036  0.04120

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.320e-15  2.437e-02    0.00   1.0000
UEM.Nigeria -5.724e+00  3.860e-01  -14.83   0.0429 *
CPI.Nigeria  5.351e-01  7.881e-02    6.79   0.0931 .
GDP.Nigeria -2.119e+00  9.562e-02  -22.16   0.0287 *
PPP.Nigeria  3.505e+00  3.195e-01   10.97   0.0579 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.0597 on 1 degrees of freedom
Multiple R-squared:  0.9993,    Adjusted R-squared:  0.9964
F-statistic: 350.4 on 4 and 1 DF,  p-value: 0.04004
             Df Sum Sq Mean Sq F value Pr(>F)
UEM.Nigeria  1 1.0838  1.0838   304.1 0.0365 *
CPI.Nigeria  1 2.0844  2.0844   584.8 0.0263 *
GDP.Nigeria  1 1.3992  1.3992   392.5 0.0321 *
PPP.Nigeria  1 0.4290  0.4290   120.4 0.0579 .
Residuals    1 0.0036  0.0036
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Lesotho <- data.frame(UEM$Lesotho, MPI$Lesotho, CPI$Lesotho, GDP$Lesotho, PPP$Lesotho)
Lmod_Lesotho = lm(MPI.Lesotho ~ ., data = Lesotho)
summary(Lmod_Lesotho)

anova_Lesotho = aov(Lmod_Lesotho)
summary(anova_Lesotho)
```

```
Call:
lm(formula = MPI.Lesotho ~ ., data = Lesotho)

Residuals:
       1        2        3        4        5        6
 0.004436  0.009241 -0.012939 -0.015937  0.027764 -0.012564

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  9.054e-16  1.557e-02   0.000   1.0000
UEM.Lesotho  3.948e-01  3.340e-02  11.820   0.0537 .
CPI.Lesotho  5.411e-03  1.996e-02   0.271   0.8315
GDP.Lesotho -4.432e-01  2.393e-02 -18.523   0.0343 *
PPP.Lesotho -5.898e-01  3.194e-02 -18.464   0.0344 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.03815 on 1 degrees of freedom
Multiple R-squared:  0.9997,    Adjusted R-squared:  0.9985
F-statistic: 858.7 on 4 and 1 DF,  p-value: 0.02559
             Df Sum Sq Mean Sq  F value Pr(>F)
UEM.Lesotho  1 2.1816  2.1816 1499.188 0.0164 *
CPI.Lesotho  1 0.0027  0.0027    1.853 0.4033
GDP.Lesotho  1 2.3182  2.3182 1593.054 0.0159 *
PPP.Lesotho  1 0.4961  0.4961  340.904 0.0344 *
Residuals    1 0.0015  0.0015
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Senegal <- data.frame(UEM$Senegal, MPI$Senegal, CPI$Senegal, GDP$Senegal, PPP$Senegal)
Lmod_Senegal = lm(MPI.Senegal ~ ., data = Senegal)
summary(Lmod_Senegal)

anova_Senegal = aov(Lmod_Senegal)
summary(anova_Senegal)
```

```
Call:
lm(formula = MPI.Senegal ~ ., data = Senegal)

Residuals:
       1        2        3        4        5        6
-0.5153  1.0161 -0.4208 -0.2364  0.4997 -0.3434

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -3.359e-16  5.625e-01   0.000    1.000
UEM.Senegal  7.256e-01  9.085e-01   0.799    0.571
CPI.Senegal -1.559e-01  8.930e-01  -0.175    0.890
GDP.Senegal -2.568e-01  8.727e-01  -0.294    0.818
PPP.Senegal  9.362e-03  7.679e-01   0.012    0.992

Residual standard error: 1.378 on 1 degrees of freedom
Multiple R-squared:  0.6203,    Adjusted R-squared:  -0.8986
F-statistic: 0.4084 on 4 and 1 DF,  p-value: 0.8073
             Df Sum Sq Mean Sq F value Pr(>F)
UEM.Senegal  1 2.6169  2.6169   1.378  0.449
CPI.Senegal  1 0.2585  0.2585   0.136  0.775
GDP.Senegal  1 0.2257  0.2257   0.119  0.789
PPP.Senegal  1 0.0003  0.0003   0.000  0.992
Residuals    1 1.8986  1.8986
```

## Findings

As we mentioned, only 12 of the 17 tests resulted in a well-fitted model. However, from the 12 well-fitted models, four tests generated favorable results to reject the null hypothesis. We identified a pattern from analyzing these four results. It seems that the significance of the predictors on the response had a hierarchal order, with UEM being the most significant across the board, followed by CPI, PPP, and lastly, GDP. Our findings suggest that, on an individual level, unemployment was the most significant indicator of poverty. Unemployment is generally connected to poverty, though it was interesting that UEM had the highest significance across most countries. Furthermore, CPI was in second place after UEM. CPI is the strongest indicator of inflation, suggesting that inflation is the second most significant cause of individual poverty. Additionally, PPP came in third place, confirming that an individuals' inability to purchase the needed goods and services directly underscores their poverty. In contrast, GDP did not present a significant effect on our model, in direct contradiction to what we expected at the start of our experiment. Low GDP significance meant the standing of an economy had no observable effect on an individual's poverty.

**Conclusion**

Our model was not a success, though not a complete failure either. We attempted to find indices that can be used as KPIs for predicting poverty on an individual level and compare how the calculations on a national and global level compare from the individual perspective. We found that how well an economy is doing did not directly affect how an individual can experience poverty. Instead, the availability of paying jobs, the cost of living, and the value of the currency used in an economy with respect to the prices of goods and services were the most significant factors. Therefore, we can conclude that our experiment successfully exposed how mainstream jargon on the economy and poverty can be misleading, serving only a select few. Finally, our model did not account for political stability, access to natural resources, and modernization. We believe these are essential variables we should consider in a future test. Furthermore, a regional approach might be helpful when considering comparing a country's situation, as it could provide an averaged benchmark to measure a country's position.

# ***References***


- https://www.worldbank.org/en/home
- https://www.wto.org
- https://www.un.org/en/
- https://www.imf.org/en/Home
- https://en.wikipedia.org/wiki/International_Monetary_Fund
- https://en.wikipedia.org/wiki/United_Nations
- https://en.wikipedia.org/wiki/World_Trade_Organization
- https://en.wikipedia.org/wiki/World_Bank
- https://en.wikipedia.org/wiki/Poverty
- https://en.wikipedia.org/wiki/Causes_of_poverty
- https://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html