Advanced Statistical Model Analysis on Kenyan Women Empowerment Indicators

Author: Ludiah M. Bagakas

A project presented for the degree of
Master of Science in Applied Statistics

Department of Mathematics and Statistics
Cleveland State University
May 2024

Supervised by Dr. Mohamed Elkhouly

Contents

1 Abstract

It is general knowledge that the overall health and empowerment of women can have various connections with the social climate and progression within different communities and regions. In this study, these various connections are examined through a series of advanced statistical models with special emphasis on **Multivariate Regression Analysis**, which is used to measure the relationship between several quantitative response variables, as well as multiple predictors. Other techniques included in this study are **Time Series, Multiple Regression, and The Genetic Algorithm for model selection.** These methods will be applied to explore the relationships between **nine women empowerment indicators** and **37 measurements of different aspects of Kenyan society. Time in years** will also be considered to account for the time series component, resulting in **38 total predictors.** To reduce multi-collinearity within the predictors of the data set, five different models are created from a subset of the predictors in categories of economics, politics, health, education, and technology.

2 Introduction

Gender equality continues to be a pressing topic within the African Diaspora. This racial/ethnic distinction is made to highlight the intersectionality of race, cultural, and gender relations. Black and African women have simultaneously and historically experienced oppression as a result of both their race/ethnic background, as well as their gender. Some of these gender-related issues come as a result of cultural practices that may be a source of pride for many individuals. Because of these unique, yet large-scale experiences, this paper will focus on a particular group within the diaspora; which is **Kenyan women.**

A multivariate approach was taken for this analysis to examine numerous measures of women empowerment that can range from health-related issues that women are susceptible to or economic variables that can indicate financial freedom. The objectives of this study range from assessing these relationships between Kenyan women empowerment indicators and each of its covariates, examining the relationships between the nine response variables, and formulating a model that can capture these truths and generate predictions.

3 Data Collection and Background

This section outlines the data collection process and provides a background of the variables considered.

The data set used for this analysis was a subset of Kenya's profile on the **World Bank** website. The original World Bank data set consisted of almost 1500 variables across time from 1960 to 2022. These variables were filtered out according to its relevancy and whether or not at least 80% of the data was available. The variables were also filtered to include measurements from 2000 to 2021, since most data is not consistently available earlier on. The following subset resulted in 22 observations and the following predictors and response variables:

Table 1: Table of Independent Variables

Indicator	**Code**
Foreign direct investment, net outflows (% of GDP)	BM.KLT.DINV.WD.GD.ZS
Urban population	SP.URB.TOTL
Rural population	SP.RUR.TOTL
Population, total	SP.POP.TOTL
GDP (current US$)	NY.GDP.MKTP.CD
Official exchange rate (LCU per US$, period average)	PA.NUS.FCRF
Exports of goods and services (current US$)	NE.EXP.GNFS.CD
Merchandise exports by the reporting economy (current US$)	TX.VAL.MRCH.WL.CD
Control of Corruption: Estimate	CC.EST
Political Stability and Absence of Violence/Terrorism: Estimate	PV.EST
CPIA gender equality rating (1=low to 6=high)	IQ.CPA.GNDR.XQ
CPIA policy and institutions for environmental sustainability rating (1=low to 6=high)	IQ.CPA.ENVR.XQ
CPIA policies for social inclusion/equity cluster average (1=low to 6=high)	IQ.CPA.SOCI.XQ
CPIA quality of public administration rating (1=low to 6=high)	IQ.CPA.PADM.XQ
Life expectancy at birth, total (years)	SP.DYN.LE00.IN
Mortality rate, infant (per 1,000 live births)	SP.DYN.IMRT.IN
Fertility rate, total (births per woman)	SP.DYN.TFRT.IN
Lifetime risk of maternal death (1 in: rate varies by country)	SH.MMR.RISK
Incidence of malaria (per 1,000 population at risk)	SH.MLR.INCD.P3
People using safely managed sanitation services, rural (% of rural population)	SH.STA.SMSS.RU.ZS
Adults (ages 15-49) newly infected with HIV	SH.HIV.INCD
People using at least basic drinking water services (% of population)	SH.H2O.BASW.ZS
Immunization, HepB3 (% of one-year-old children)	SH.IMM.HEPB
Immunization, measles (% of children ages 12-23 months)	SH.IMM.MEAS
Immunization, DPT (% of children ages 12-23 months)	SH.IMM.IDPT
Number of under-five deaths	SH.DTH.MORT
Number of neonatal deaths	SH.DTH.NMRT
Compulsory education, duration (years)	SE.COM.DURS
Adjusted savings: education expenditure (% of GNI)	NY.ADJ.AEDU.GN.ZS
School enrollment, primary (% gross)	SE.PRM.ENRR
School enrollment, preprimary (% gross)	SE.PRE.ENRR
Expenditure on tertiary education (% of government expenditure on education)	SE.XPD.TERT.ZS
Expenditure on primary education (% of government expenditure on education)	SE.XPD.PRIM.ZS

Indicator	Code
Fixed telephone subscriptions	IT.MLT.MAIN
Computer, communications and other services (% of commercial service imports)	TM.VAL.OTHR.ZS.WT
Transport services (% of service imports, BoP)	BM.GSR.TRAN.ZS
Access to electricity, rural (% of rural population)	EG.ELC.ACCS.RU.ZS
Access to electricity (% of population)	EG.ELC.ACCS.ZS

Table 2: Table of Response Variables

Indicator	Code
Fertility rate, total (births per woman)	SP.DYN.TFRT.IN
Mortality rate, adult, female (per 1,000 female adults)	SP.DYN.AMRT.FE
Prevalence of HIV, female (% ages 15-24)	SH.HIV.1524.FE.ZS
Population, female (% of total population)	SP.POP.TOTL.FE.ZS
Life expectancy at birth, female (years)	SP.DYN.LE00.FE.IN
Employment in agriculture, female (% of female employment) (modeled ILO estimate)	SL.AGR.EMPL.FE.ZS
Employment in industry, female (% of female employment) (modeled ILO estimate)	SL.IND.EMPL.FE.ZS
Contributing family workers, female (% of female employment) (modeled ILO estimate)	SL.FAM.WORK.FE.ZS
Suicide mortality rate, female (per 100,000 female population)	SH.STA.SUIC.FE.P5

Tables 1 and 2 provide each variable and the code they were assigned. In this analysis it is important to consider varying aspects of women empowerment to account for its many different forms.

4 Examination of Time Series

The first variable, fertility rate (average number of births per women) is essential in discussing the reproductive health and climate for women. The time series plot for fertility rate in Figure 1 shows a decline in the fertility rates across time which is pretty consistent with the rest of the world. According to the World Bank, the most current reported fertility rate in Kenya is 3.34 (2021), while in all of Sub-Saharan Africa, this rate is 4.6. It is generally stated that there is a positive association between rates of poverty and reproduction rates. Individuals that reside in countries that are considered more developed tend to have access to modern contraceptives, hence their lower fertility rates. Kenya's poverty rate is around 36% which is pretty mid-range in comparison to other Saharan African countries. Countries with higher poverty rates, like Somalia with a birth rate of 6.31, would be considered outliers that skew the distribution of fertility rates in Sub-Saharan Africa to the right.

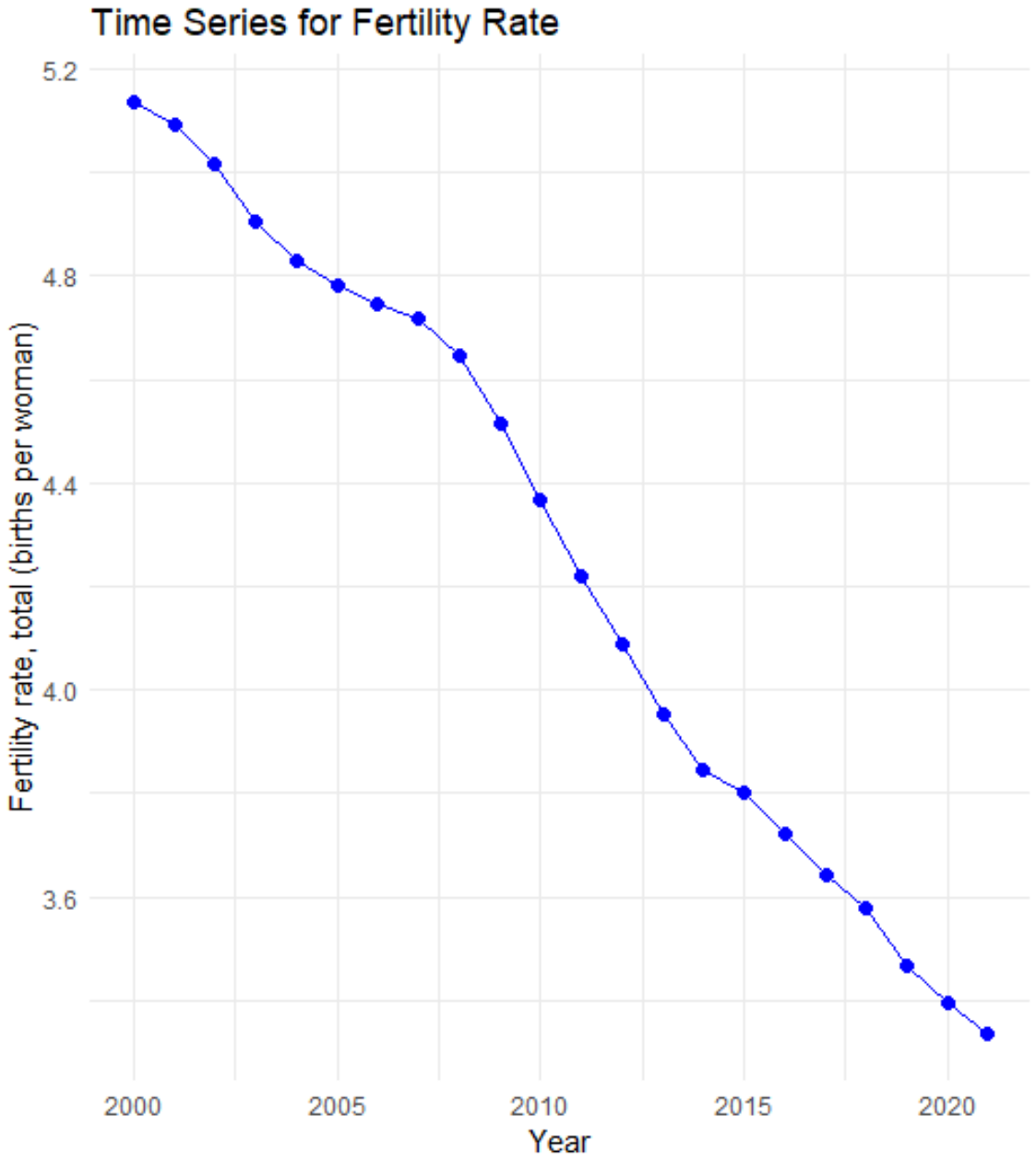

Figure 1: Time Series for Fertility Rate

Variables like mortality rate and life expectancy have implications in healthcare, violence, and financial privilege. As one would expect, the general trend for Mortality decreases and the general trend for Life Expectancy increases. These patterns are expected across time due to medical and

technological advances that help prolong life expectancy and decrease death rates. There appears to be some slight seasonality occurring in the time series plot for mortality rates. Local maximums of mortality occur during 2010, 2013, 2016, and a spike at 2021. These times in which these values increase are at or near elections. The increase of mortality rates could potentially be explained by post-election violence or other conflicts. For example, there was a mass shooting in one of the largest most populated malls in Kenya, known as the Westgate Mall in 2013. This was also the same year Uhuru Kenyatta was elected president and per usual, violence occured following the election. Additionally, the increase in mortality around 2019 to 2021 could be a result of COVID-19 deaths, where life expectancy also drops.

These variables aim to simultaneously address hidden components of mortality and life expectancy in women, like rates of femicide and domestic violence (where data is limited).

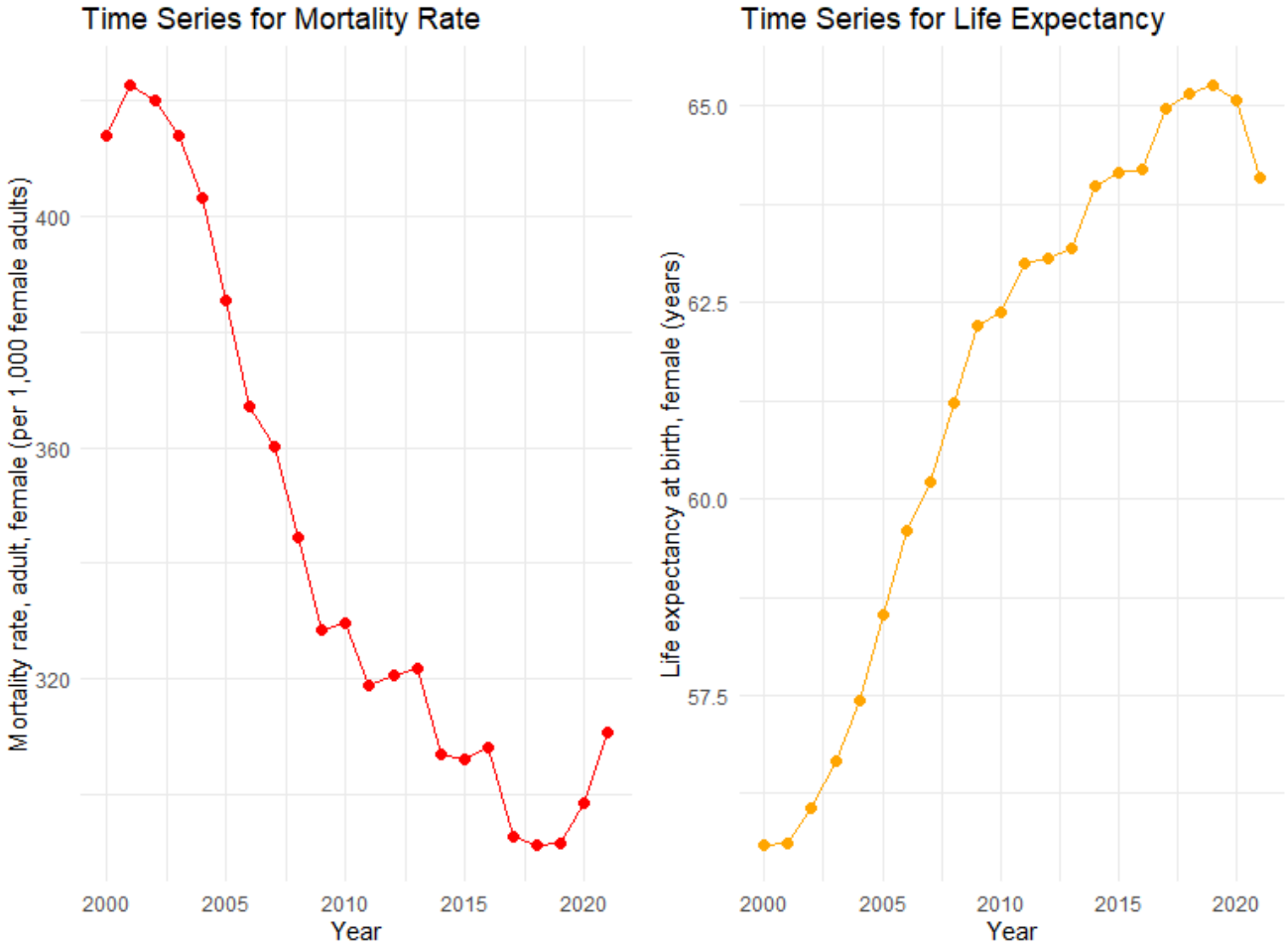

Figure 2: Time Series for Mortality Rate and Life Expectancy

The more optimistic side of this analysis relates to woman and career development. Two of these response variables are the percentage of female employment in agriculture and the percentage of female employment in industry. These variables include ILO imputations created by the World Bank to handle missing data points. As expected, the time series plots show that as agriculture employment for women decreases, industry employment increases. One can infer that there is a lot less demand for agricultural workers with the increase of industrialization and technological advancements.

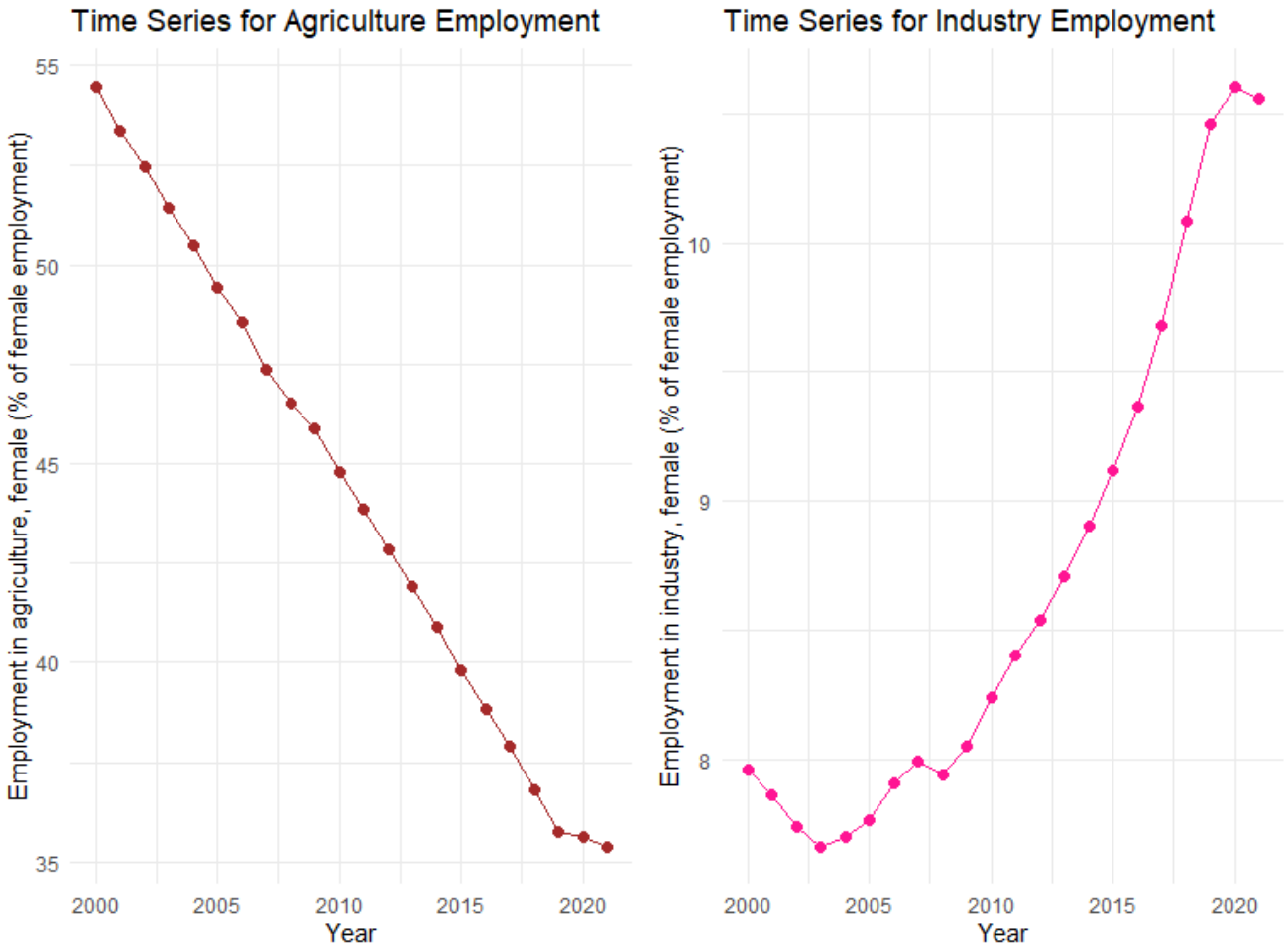

Figure 3: Time Series for

The variable for prevalence of HIV in women aged (18-25) is a percentage calculated from those who are newly diagnosed. This variable can be relevant to the overall argument surrounding health. HIV rates are also indications of sexual education and empowerment, as well as access to contraception. Given that The time series plot for HIV Prevalence decreases almost consistently across time, it can be inferred that these indications of sexual education and empowerment have grown with time.

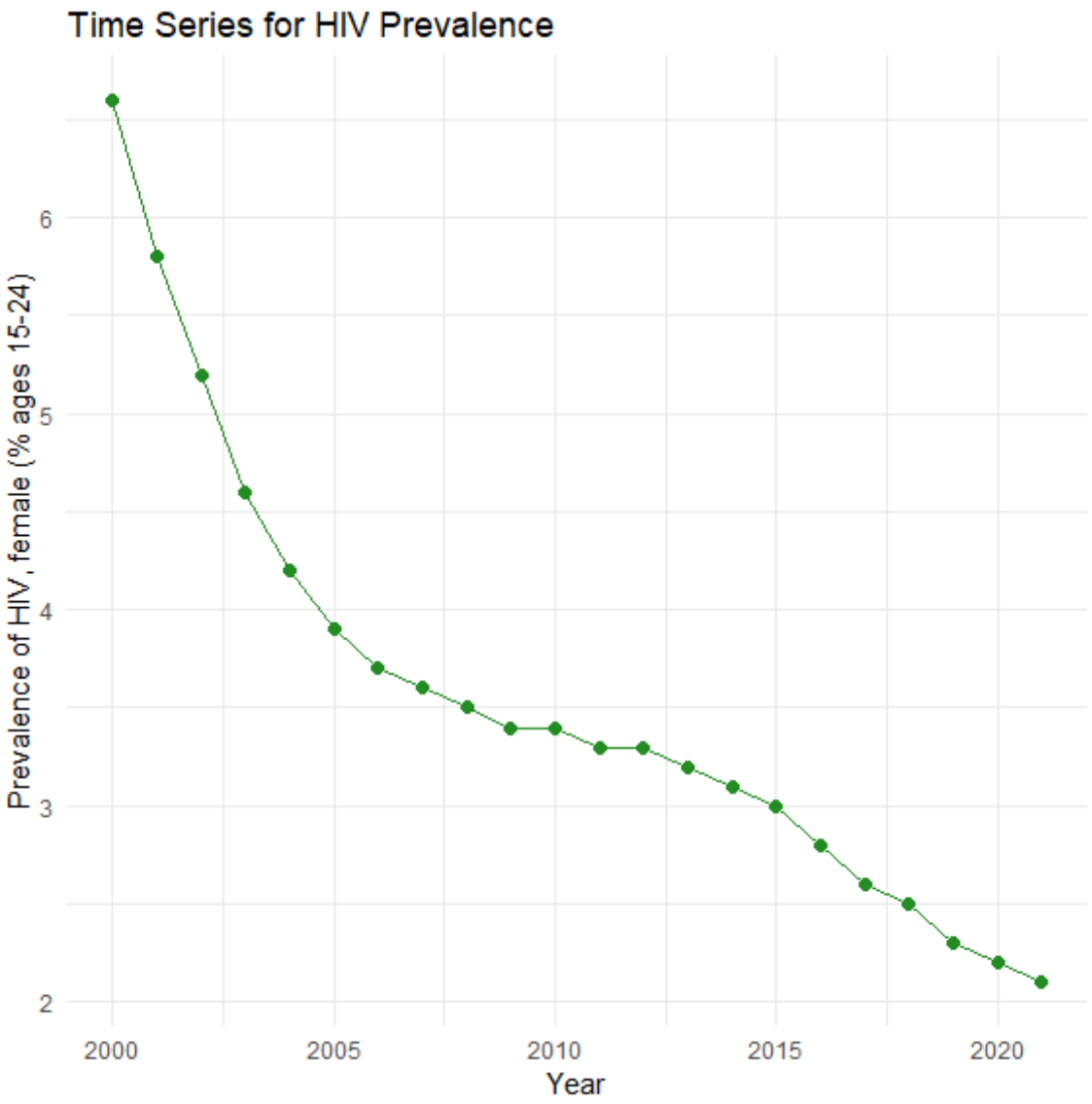

Figure 4: Time Series for HIV Prevalence

One variable that relates to both women empowerment in career and at home is the percentage of women financially contributing to their households, which also contains ILO imputations. The graph for this variable is a bit hard to interpret as there seems to be two separate functions. This may be a result of the imputations and produce some bias in the results.

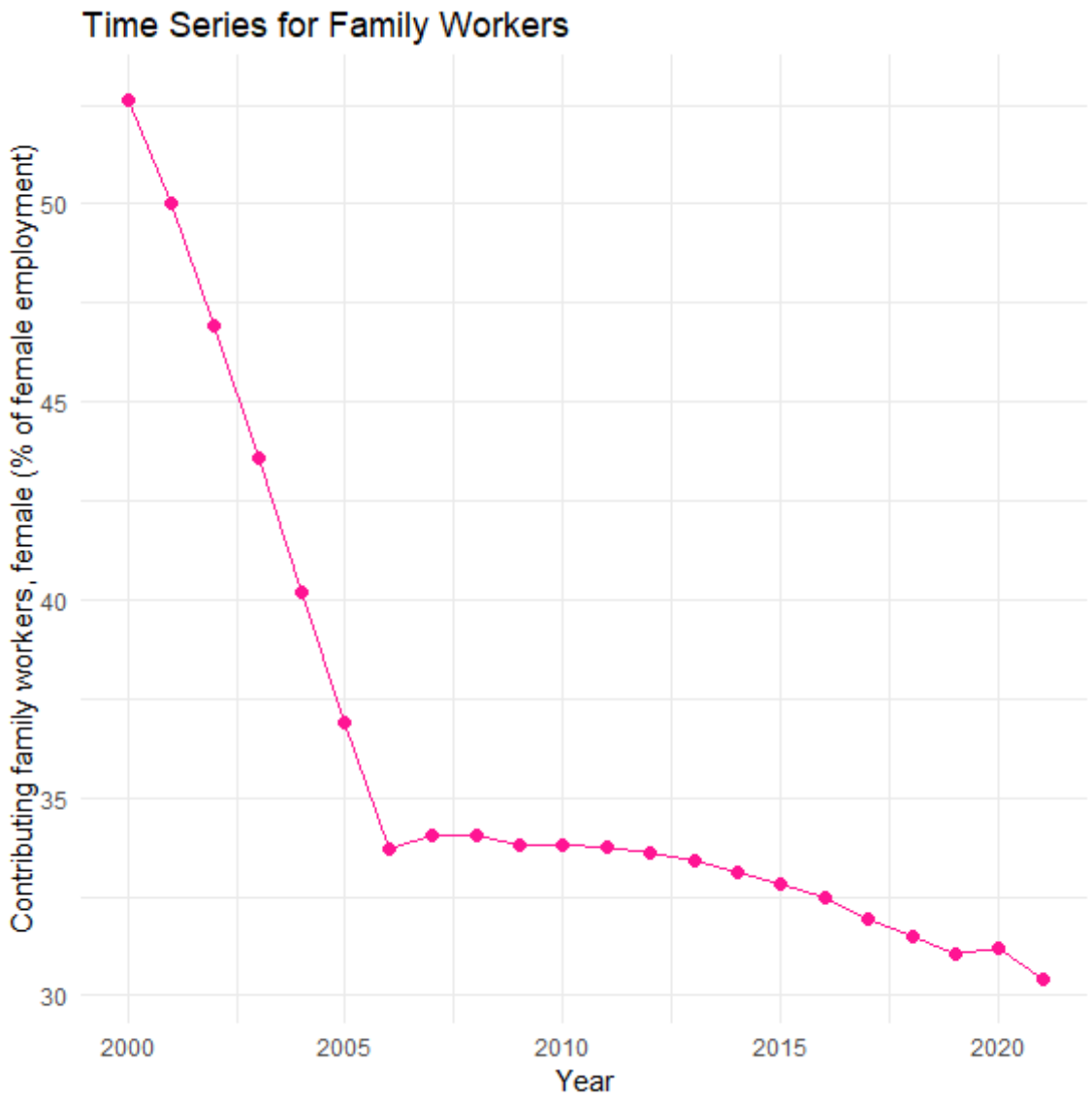

Figure 5: Time Series for Contributing Family Workers

Suicide mortality rate in women is measured in individuals per 100,000 women. This is a valuable predictor as it relates to mental health, which is a topic of concern across all demographics. The time series plot for suicide rates illustrates a sporadic unpredictable pattern across time after the year 2004. It is difficult to gauge where this pattern comes from, but one could infer that suicide rates, like mortality, arise during historical conflicts.

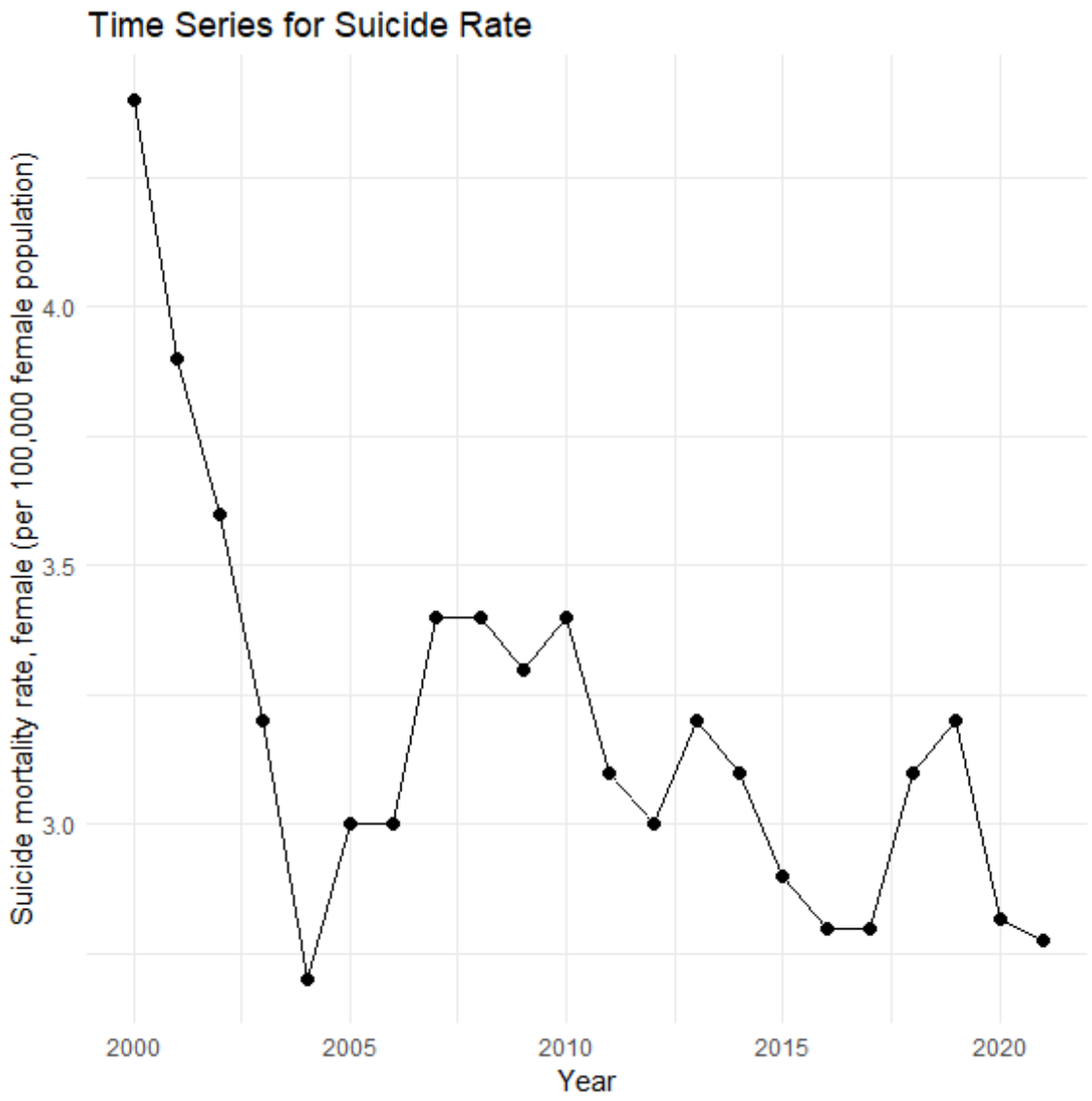

Figure 6: Time Series for Contributing Family Workers

Population is a general measurement to be considered, as it relates to just about anything involving health, social climate, mortality, etc. This specific variable measures the national percentage of women. When these numbers drop or rise, it can hint at some event where women or men are being disproportionately affected or even an increase or decrease in migration. The time series for population follows a quadratic pattern where the minimum value occurs at the year 2010. This is hard to interpret, since these are percentages. Upon further research, Human Right Watch reports that some of the events that occurred leading up to 2010 was post-election violence following the

election of Mwai Kibaki and the immigration of Somali refugees. It is possible that during this time, women were emigrating or disproportionately killed after the election. Another theory is that most Somali refugees that migrated to Kenya were men and therefore decreased the percentage of women in Kenya.

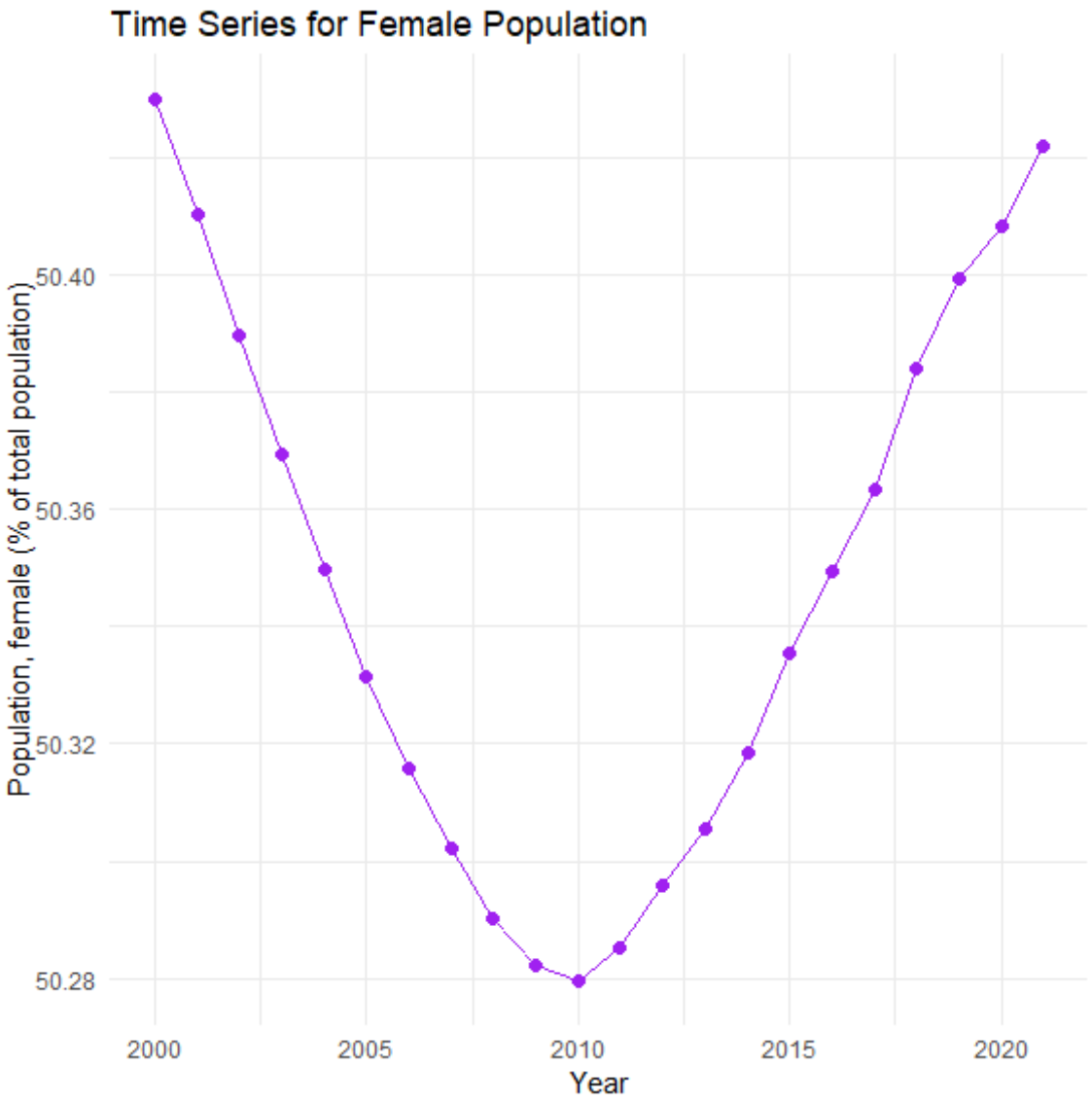

Figure 7: Time Series for Female Percentage of Population

As noted in the evaluation of time series, many data points corresponding to the national climate in Kenyan are missing and this can lead to heavily biased and volatile model results if not handled

correctly. The next section will expand on these challenges and discuss resolutions.

5 Approach to Missing Values

5.1 Remark

One of the most troublesome obstacles when conducting this analysis was navigating the many missing values in Kenya's data sets. The data set was obtained from the World Bank website which includes thousands of different variables that describe different conditions in Kenya across time, but a vast majority of these variables had very few data points. The issue of missing data is especially common when the population of interest is marginalized or considered 'underdeveloped' by Western standards. This is the case with most African Countries, especially when considering a population of African women. To avoid problematic and biased results, any variable that contained less than 80% of data from 2000-2022, was excluded from this analysis. Unfortunately, many variables that could have been significant (like literacy rates, number of physicians, and most education-related variables) in the interpretations of this study were eliminated.

5.2 Handling of Missing Values

The missing values were imputed using the regression equation $\hat{y} = \beta_0 + \beta t$ for each of missing variables in the data, considering time t in years. Using time as the only independent variable in the regression imputation processes seemed almost ideal, since time is the only variable that is consistently non-missing, however it neglects the other relationships in the data set, which can in turn lead to other biases.

Table 3: Number of NA's in Variables

Variable	Number of NA's
Merchandise exports by the reporting economy (current US$)	1
Control of Corruption: Estimate	1
Political Stability and Absence of Violence/Terrorism: Estimate	1
CPIA gender equality rating (1=low to 6=high)	5
CPIA policy and institutions for environmental sustainability rating (1=low to 6=high)	5
CPIA policies for social inclusion/equity cluster average (1=low to 6=high)	5
CPIA quality of public administration rating (1=low to 6=high)	5
Lifetime risk of maternal death (1 in: rate varies by country)	1
Immunization, HepB3 (% of one-year-old children)	2
School enrollment, primary (% gross)	5
School enrollment, preprimary (% gross)	5
Expenditure on tertiary education (% of government expenditure on education)	12
Expenditure on primary education (% of government expenditure on education)	12
Suicide mortality rate, female (per 100,000 female population)	2

The suicide rates for women were imputed for the year 2000 and 2021. The imputed values seem to correspond to the trend of the where values increase, decrease and then plateau a little bit.

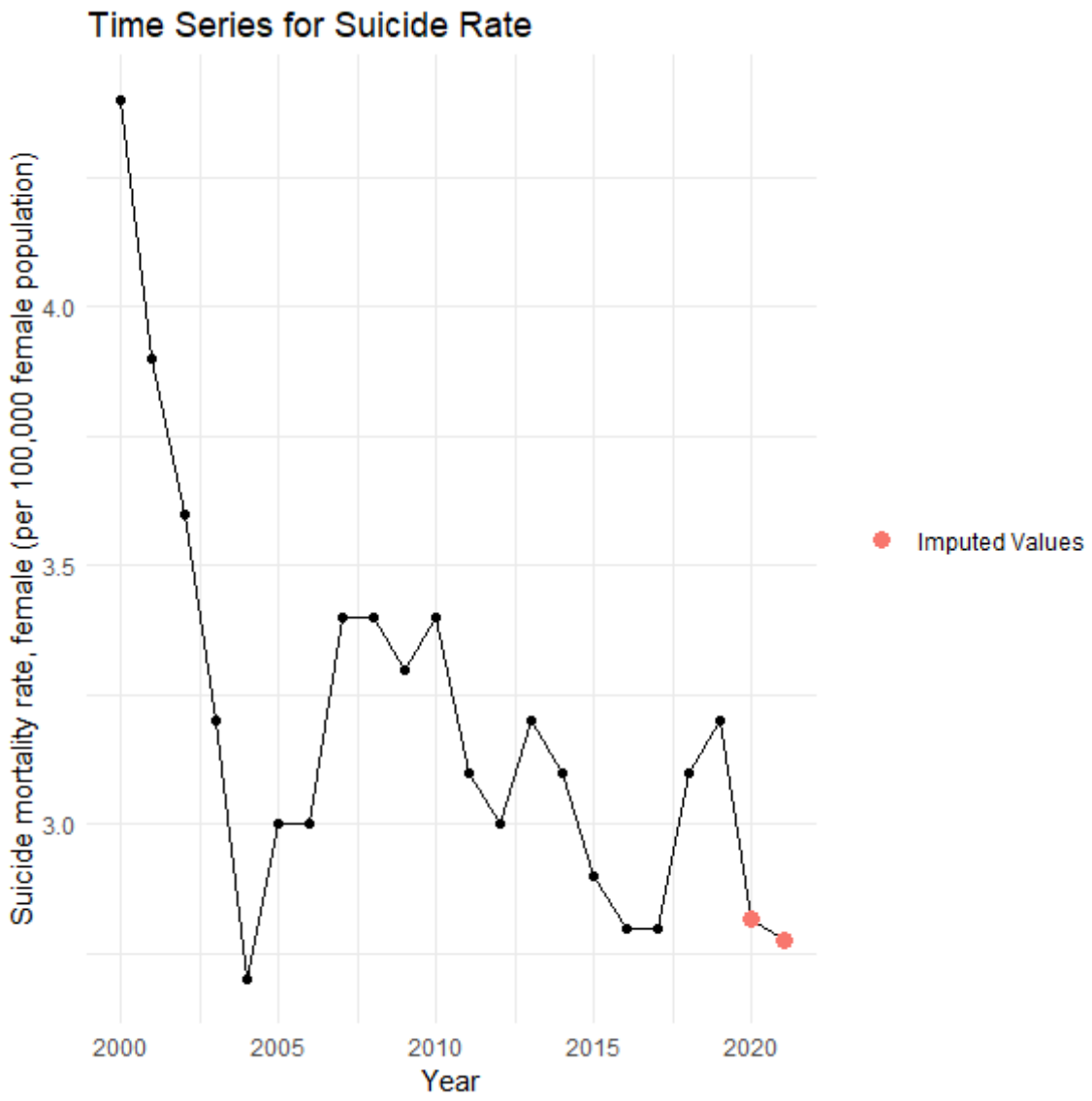

Figure 8: Time Series for Suicide Rates with Imputed Values

6 Exploratory Data Analysis

The EDA plots for each of the response variables are in **Figures 9 through 17**. Here are the comments:

- **EDA Plot of Fertility Rates:** The fertility rates follow a slightly bi-modal distribution as indicated by the two peaks in the histogram. The normal Q-Q plot contains scattered data

points on both the right and left corners hinting to a slight lack of normality. The density and box-plots appear normal with no outliers.

- **EDA Plot of Mortality Rates:** The mortality rates follow a skewed-right distribution as indicated by the histogram, box, and density plots. The data points in the normal Q-Q plot follow a slight cubic pattern hinting to a lack of normality. No outliers are visible.
- **EDA Plot of HIV Prevalence:** The HIV rates follow a skewed-right distribution as indicated by the histogram, normal Q-Q, and density plots. The data points in the normal Q-Q plot are scattered towards the right corner (skewed-right). Two outliers are visible in the box-plot.
- **EDA Plot of Female Population:** The Female Population percentages follow a slightly bi-modal distribution as indicated by the two peaks in the histogram. The normal Q-Q plot contains scattered data points, but appears approximately normal. The density and box-plot appear almost normal with no outliers visible.
- **EDA Plot of Life Expectancy:** The life expectancy ages follow a skewed-right distribution as indicated by the histogram, box, and density plots. The data points in the normal Q-Q plot follow a slight cubic pattern hinting to a lack of normality. No outliers are visible.
- **EDA Plot of Employment in Agriculture:** The female agriculture employment rates follow a slightly skewed-right but mostly normal distribution as indicated by the histogram. The density, box, and normal Q-Q plots appear normal.
- **EDA Plot of Employment in Industry:** The female industry employment rates follow a skewed-right distribution as indicated by the histogram, box, and density plots. The data points in the normal Q-Q plot follow a slight cubic pattern hinting to a lack of normality. No outliers are visible.
- **EDA Plot of Female Financial Contribution to Household:** The rates of female financial contribution to households follow a skewed-right distribution as indicated by all four plots. There are four prominent outliers that may affect the results of the analysis.
- **EDA Plot of Suicide Rates:** The female suicide rates follow a skewed-right distribution as indicated by the histogram, density, and normal Q-Q plots. One outlier is visible in the box-plot.

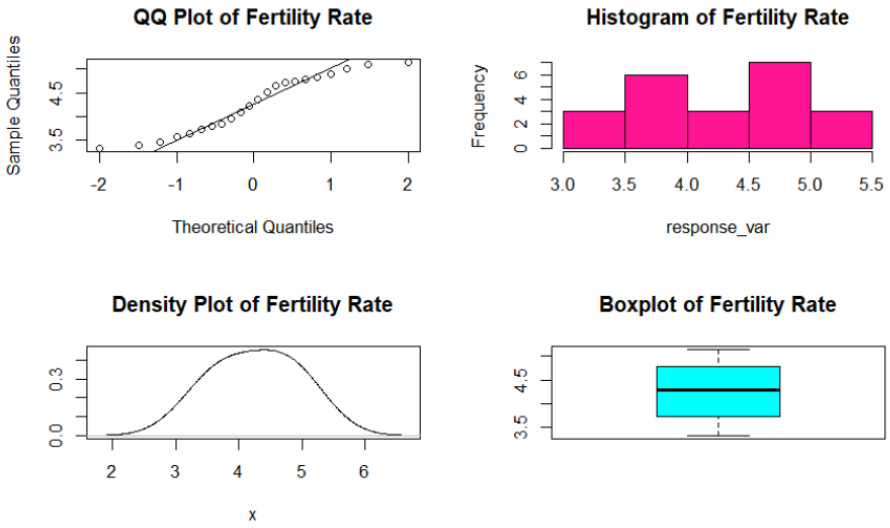

Figure 9: EDA Plots for Fertility Rate

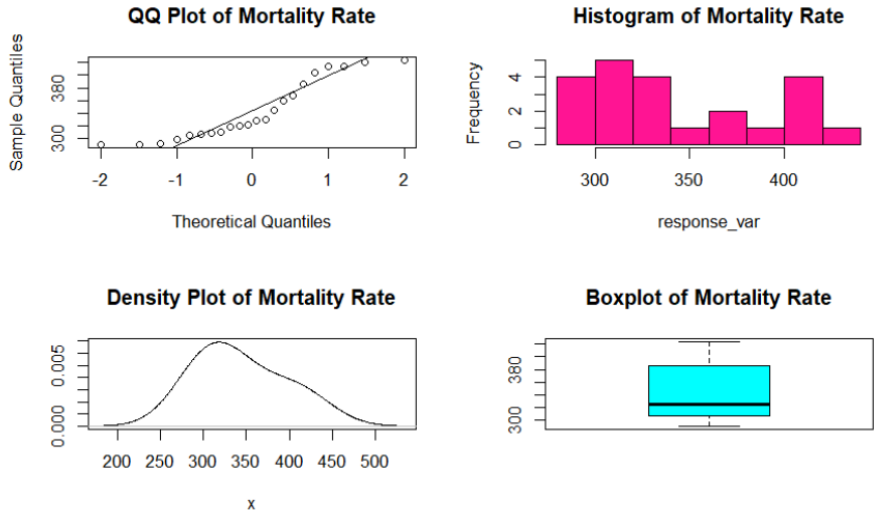

Figure 10: EDA Plots for Mortality Rate

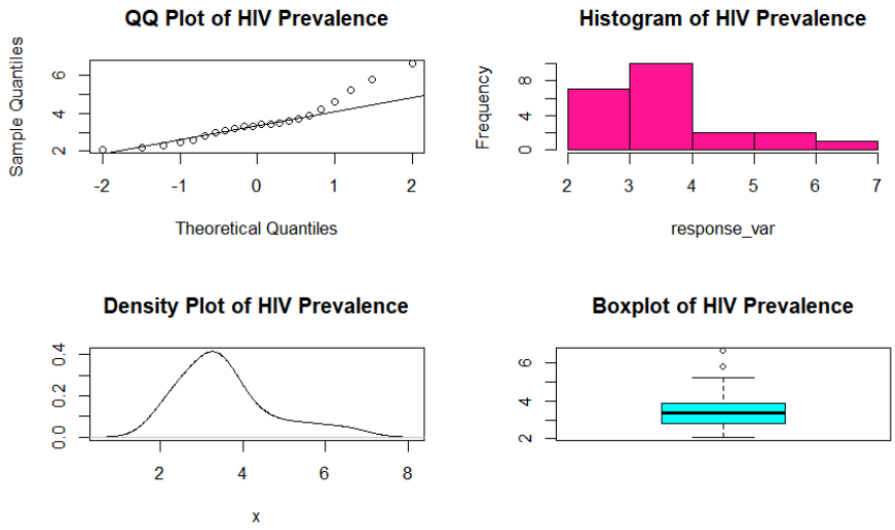

Figure 11: EDA Plots for HIV Prevalence

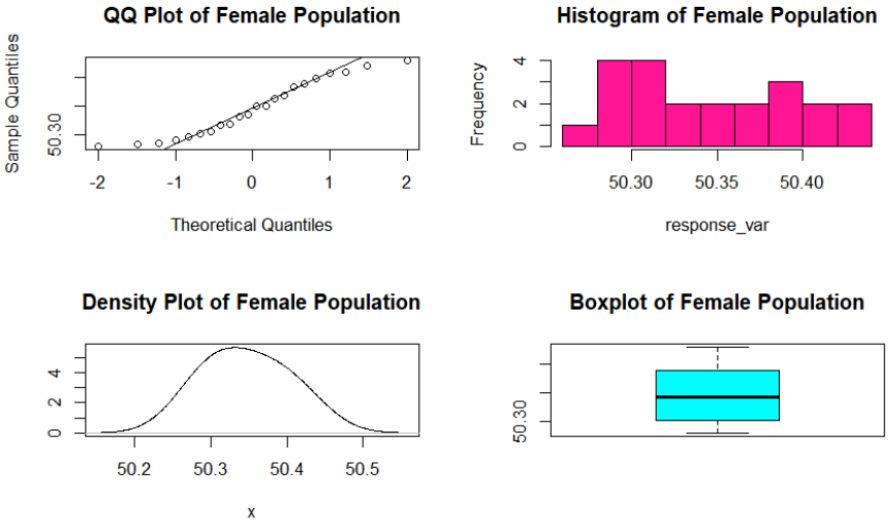

Figure 12: EDA Plots for Female Population

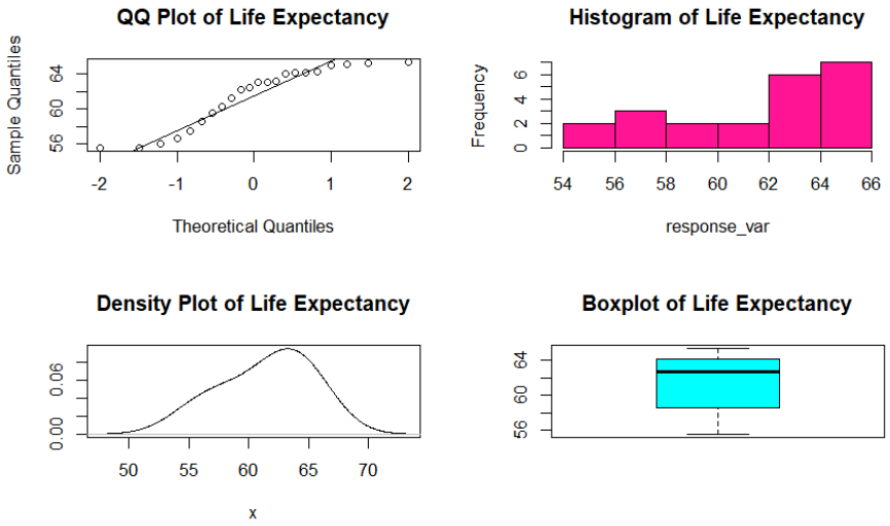

Figure 13: EDA Plots for Life Expectancy

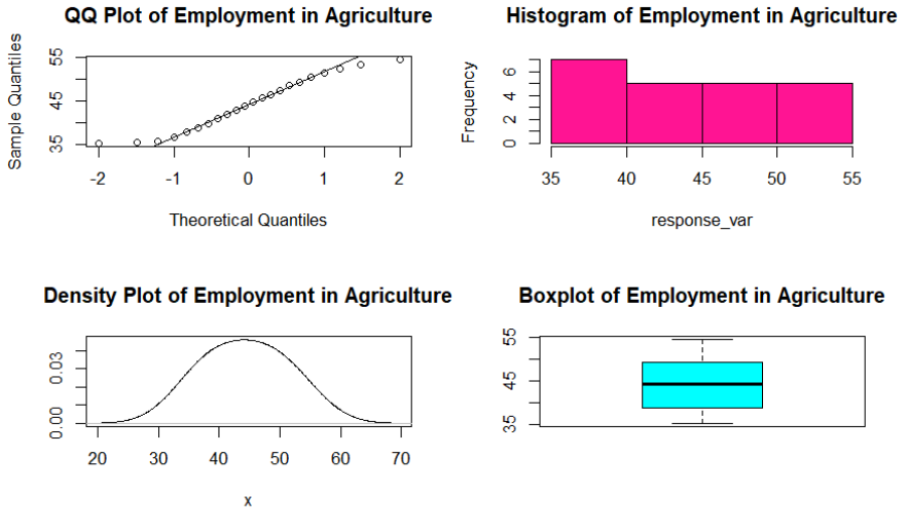

Figure 14: EDA Plots for Agriculture Employment

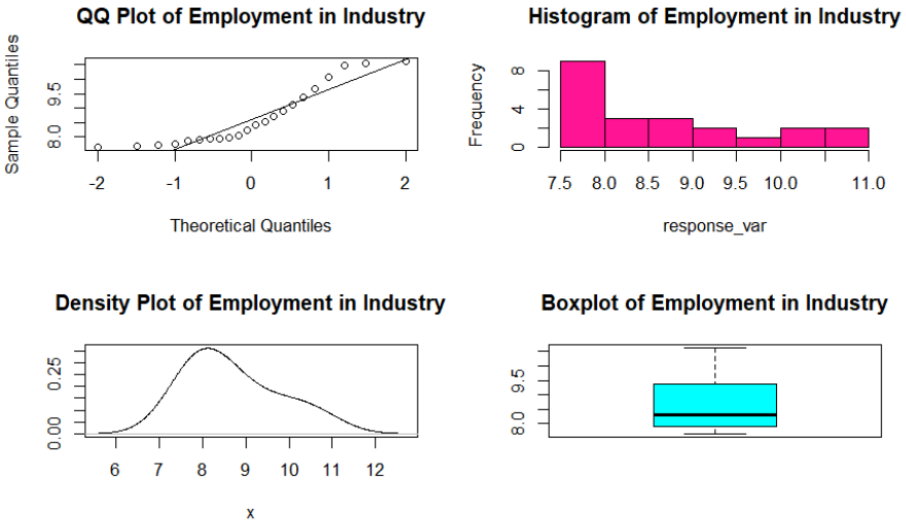

Figure 15: EDA Plots for Industry Employment

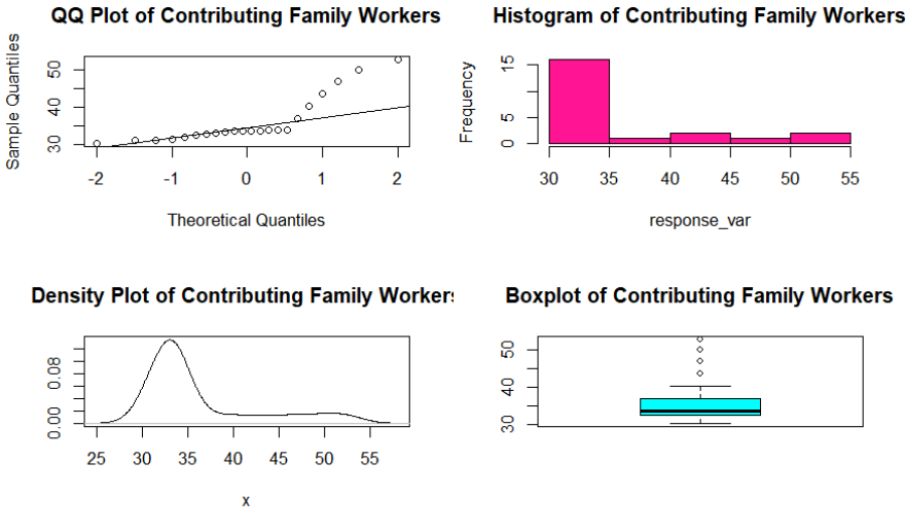

Figure 16: EDA Plots for Family Workers

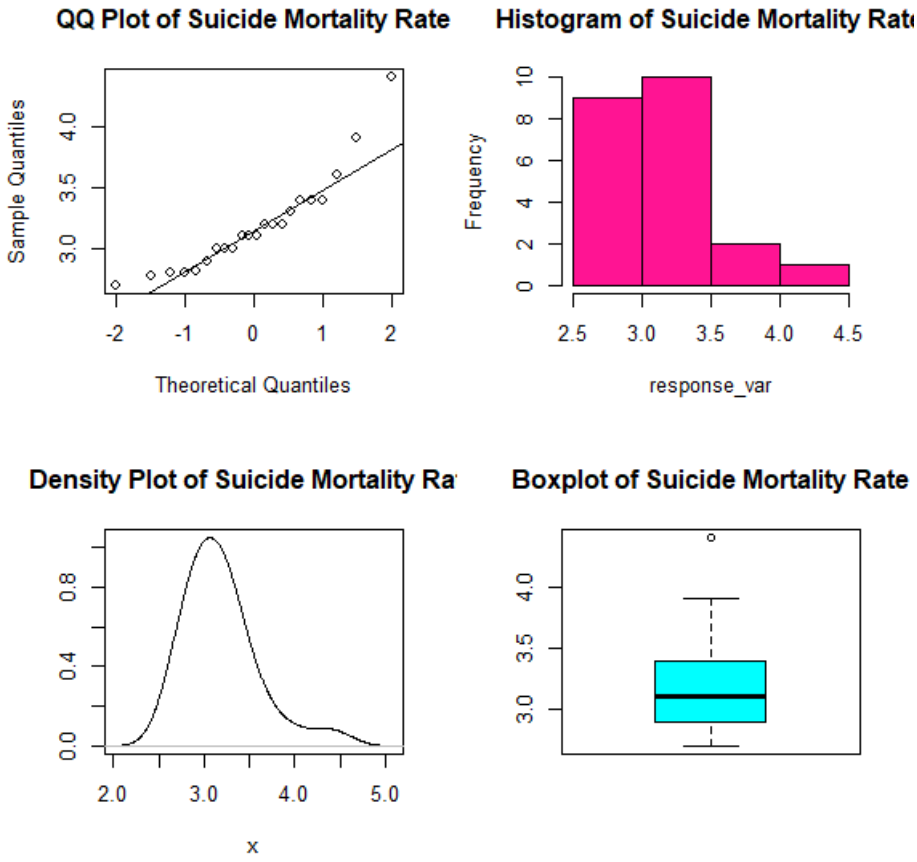

Figure 17: EDA Plots for Suicide Rates

These evaluations of the response variables may affect the distribution of our residuals in the final step. Most of the univariate outliers may not be harmful in the multivariate context.

7 Assumptions

In order to prepare for multivariate analysis, a linear multiple regression is fit for each of the nine women empowerment indicators for all five categories (45 total models). **The raw summaries of these models are shown in the appendix section of the report.** This section examines the multivariate and univariate correspondence to the assumptions of regression analysis. These assumptions will be re-examined with further inspection after the genetic algorithm is applied.

Consider the multivariate model matrix:

$$\begin{bmatrix} Y_{11} & Y_{12}...Y_{1m} \\ Y_{21} & Y_{22}...Y_{2m} \\ ... & \\ Y_{n1} & Y_{n2}...Y_{nm} \end{bmatrix} = \begin{bmatrix} z_{10} & z_{11}...z_{1m} \\ z_{20} & z_{21}...z_{2m} \\ ... & \\ z_{n0} & z_{n1}...Y_{nm} \end{bmatrix} \begin{bmatrix} \beta_{10} & \beta_{11}...\beta_{1m} \\ \beta_{20} & \beta_{21}...\beta_{2m} \\ ... & \\ \beta_{r0} & \beta_{r1}...Y_{rm} \end{bmatrix} + \begin{bmatrix} \epsilon_{11} & \epsilon_{12}...\epsilon_{1m} \\ \epsilon_{21} & \epsilon_{22}...\epsilon_{2m} \\ ... & \\ \epsilon_{n1} & \epsilon_{n2}...\epsilon_{nm} \end{bmatrix}$$

The assumptions required for multiple regression can be generalized to the multivariate case.

Collinearity: Multi-collinearity is volatile in Regression analysis. When severe collinearity is present in the predictors of the data set, the linear combinations of the predictors result in singular matrices. These singularities inflate the diagonal entries causing the calculations to be numerically unstable. The correlation plots in **Figures 18 through 22** illustrate the correlation between each of the predictors. Larger, more pigmented circles indicate higher correlation coefficients. Most of the predictors are correlated, especially in the category of health. A typical strategy of avoiding these occurrences is by removing highly-correlated predictors, however this method may result in loss of information. The full model matrix produced several missing values indicating severe multi-collinearity. **The Genetic Algorithm** may help resolve this issue, since predictors that are harmful to the model will be eliminated one by one and can reduce the complexity of the model. However, the 'GA' function in R does not take missing values (which may be present in the model matrix when severe collinearity is present), so collinearity should be reduced *prior* to applying the Genetic Algorithm.

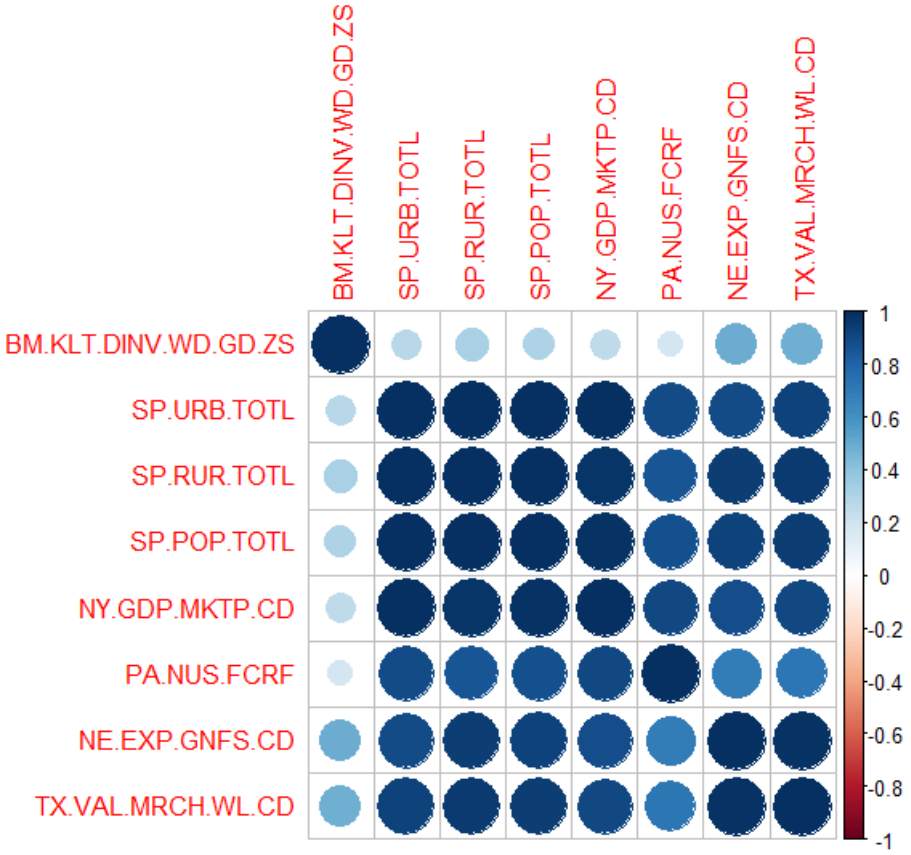

Figure 18: Correlation Plot for Economic Predictors

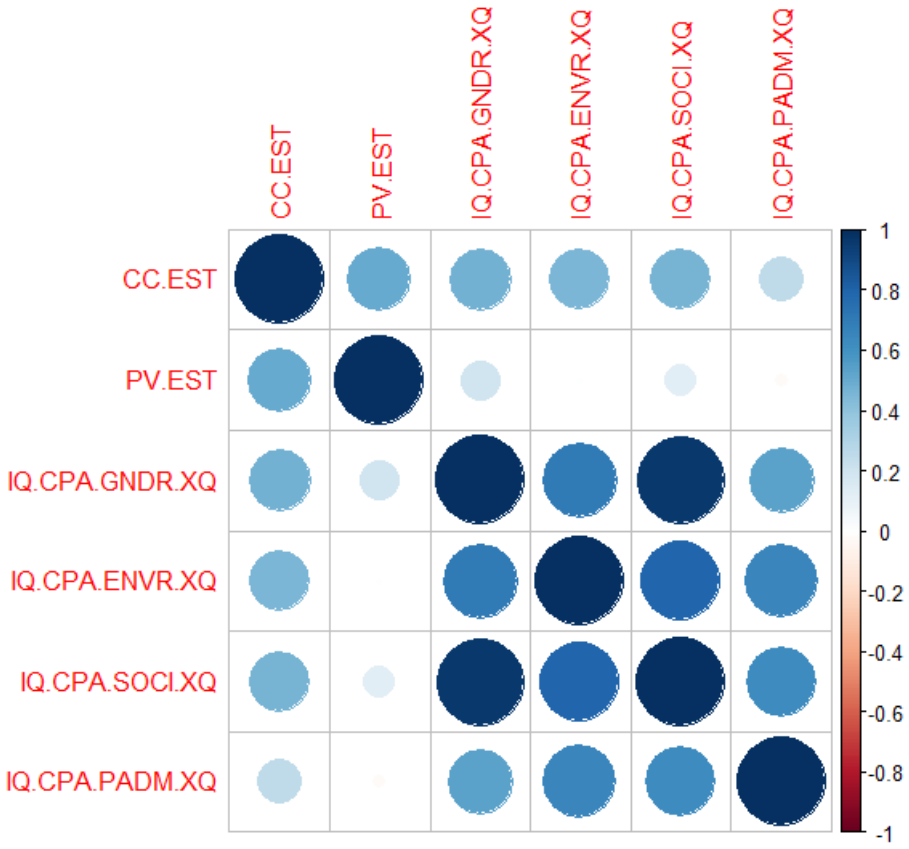

Figure 19: Correlation Plot for Political Predictors

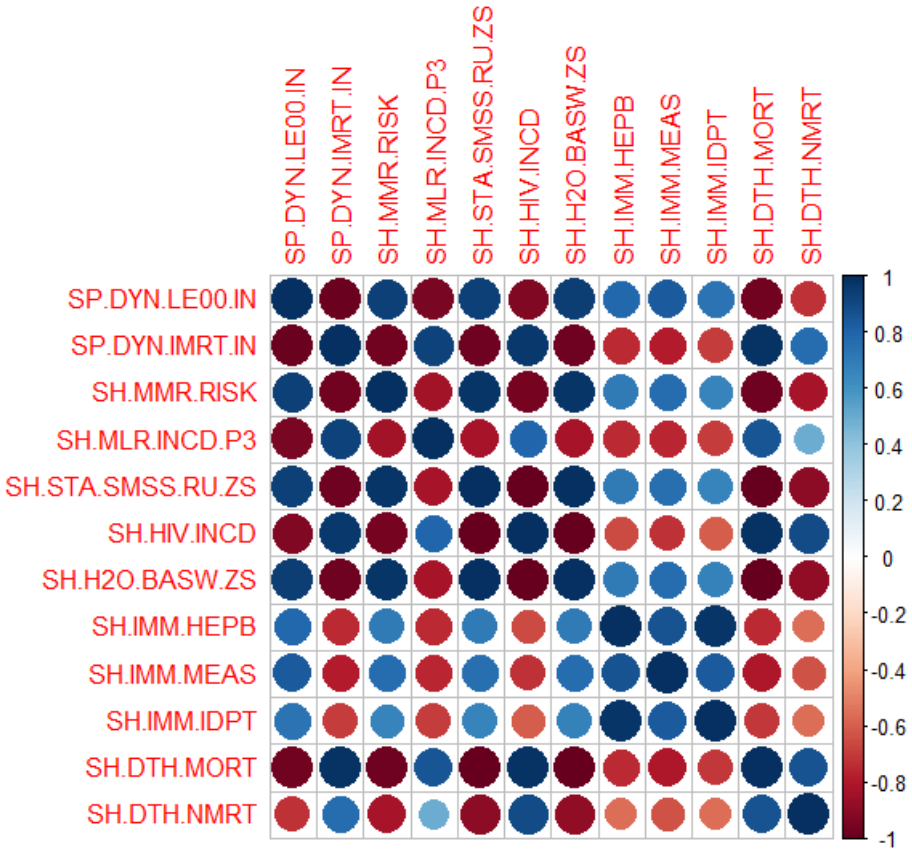

Figure 20: Correlation Plot for Health Predictors

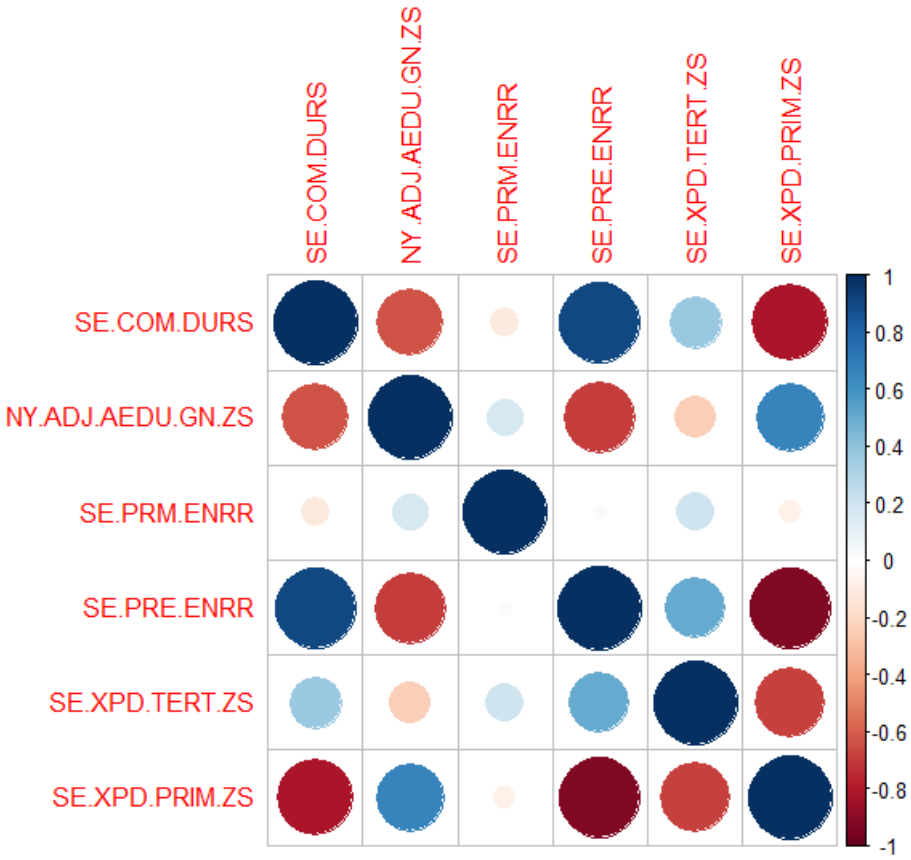

Figure 21: Correlation Plot for Education Predictors

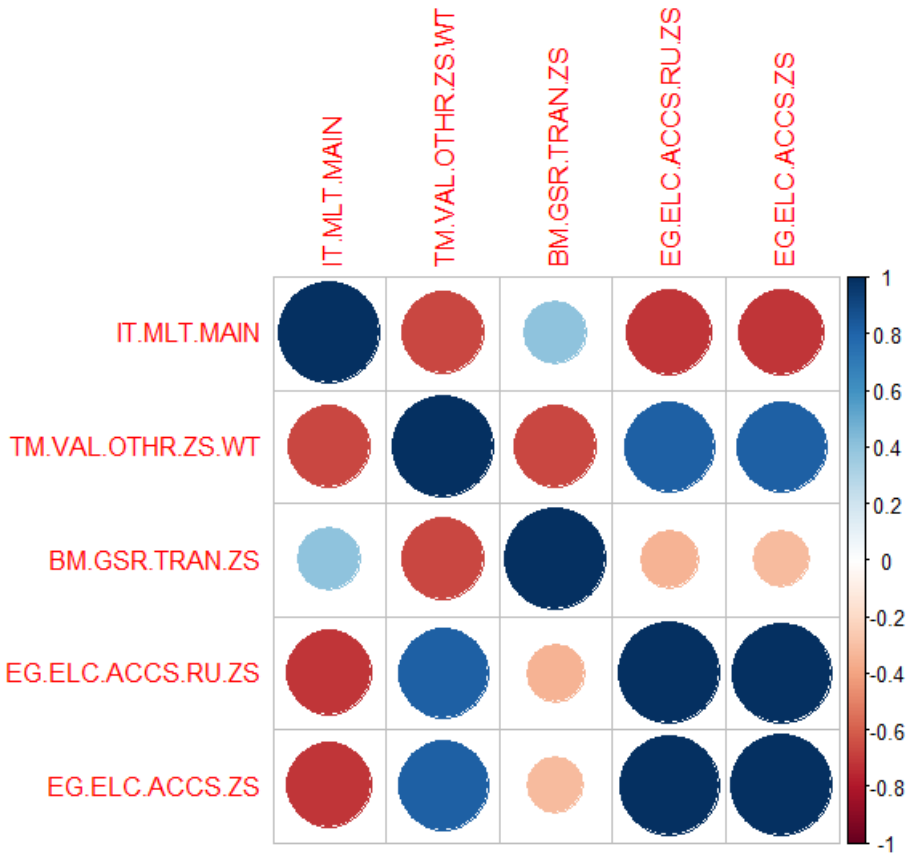

Figure 22: Correlation Plot for Technology Predictors

To overcome collinearity without removing too many predictors, the predictors were subset into five different categories consisting of economic, political, health, education, and technological-related variables. The remainder of the analysis is applied to **five separate models** using the subsets of the predictors and **the original nine response variables.**

Here are the five categories of predictors:

Table 4: Summary of Predictors by Category

Category	Indicator Code	Indicator Name
Economic	BM.KLT.DINV.WD.GD.ZS	Foreign direct investment, net outflows (% of GDP)
Economic	SP.URB.TOTL	Urban population
Economic	SP.RUR.TOTL	Rural population
Economic	SP.POP.TOTL	Population, total
Economic	NY.GDP.MKTP.CD	GDP (current US$)
Economic	PA.NUS.FCRF	Official exchange rate (LCU per US$, period average)
Economic	NE.EXP.GNFS.CD	Exports of goods and services (current US$)
Economic	TX.VAL.MRCH.WL.CD	Merchandise exports by the reporting economy (current US$)
Political	CC.EST	Control of Corruption: Estimate
Political	PV.EST	Political Stability and Absence of Violence/Terrorism: Estimate
Political	IQ.CPA.GNDR.XQ	CPIA gender equality rating (1=low to 6=high)
Political	IQ.CPA.ENVR.XQ	CPIA policy and institutions for environmental sustainability rating
Political	IQ.CPA.SOCI.XQ	CPIA policies for social inclusion/equity cluster average
Political	IQ.CPA.PADM.XQ	CPIA quality of public administration rating
Health	SP.DYN.LE00.IN	Life expectancy at birth, total (years)
Health	SP.DYN.IMRT.IN	Mortality rate, infant (per 1,000 live births)
Health	SH.MMR.RISK	Lifetime risk of maternal death (1 in: rate varies by country)
Health	SH.MLR.INCD.P3	Incidence of malaria (per 1,000 population at risk)
Health	SH.STA.SMSS.RU.ZS	People using safely managed sanitation services, rural
Health	SH.HIV.INCD	Adults (ages 15-49) newly infected with HIV
Health	SH.H2O.BASW.ZS	People using at least basic drinking water services (% of population)
Health	SH.IMM.HEPB	Immunization, HepB3 (% of one-year-old children)
Health	SH.IMM.MEAS	Immunization, measles (% of children ages 12-23 months)
Health	SH.IMM.IDPT	Immunization, DPT (% of children ages 12-23 months)
Health	SH.DTH.MORT	Number of under-five deaths
Health	SH.DTH.NMRT	Number of neonatal deaths
Education	SE.COM.DURS	Compulsory education, duration (years)
Education	NY.ADJ.AEDU.GN.ZS	Adjusted savings: education expenditure (% of GNI)
Education	SE.PRM.ENRR	School enrollment, primary (% gross)
Education	SE.PRE.ENRR	School enrollment, preprimary (% gross)
Education	SE.XPD.TERT.ZS	Expenditure on tertiary education
Education	SE.XPD.PRIM.ZS	Expenditure on primary education
Technology	IT.MLT.MAIN	Fixed telephone subscriptions
Technology	TM.VAL.OTHR.ZS.WT	Computer, communications and other services
Technology	BM.GSR.TRAN.ZS	Transport services (% of service imports, BoP)
Technology	EG.ELC.ACCS.RU.ZS	Access to electricity, rural (% of rural population)
Technology	EG.ELC.ACCS.ZS	Access to electricity (% of population)

The following independent variables are removed from each model to reduce the correlation between predictors.

Table 5: Summary of Omitted Predictors

Category	Indicator Code	Indicator Name
Economic	BM.KLT.DINV.WD.GD.ZS	Foreign direct investment, net outflows (% of GDP)
Economic	~~SP.URB.TOTL~~	~~Urban population~~
Economic	~~SP.RUR.TOTL~~	~~Rural population~~
Economic	~~SP.POP.TOTL~~	~~Population, total~~
Economic	~~NY.GDP.MKTP.CD~~	~~GDP (current US$)~~
Economic	PA.NUS.FCRF	Official exchange rate (LCU per US$, period average)
Economic	~~NE.EXP.GNFS.CD~~	~~Exports of goods and services (current US$)~~
Economic	~~TX.VAL.MRCH.WL.CD~~	~~Merchandise exports by the reporting economy (current US$)~~
Political	CC.EST	Control of Corruption: Estimate
Political	PV.EST	Political Stability and Absence of Violence/Terrorism: Estimate
Political	~~IQ.CPA.GNDR.XQ~~	~~CPIA gender equality rating (1=low to 6=high)~~
Political	IQ.CPA.ENVR.XQ	CPIA policy and institutions for environmental sustainability rating
Political	IQ.CPA.SOCI.XQ	CPIA policies for social inclusion/equity cluster average
Political	IQ.CPA.PADM.XQ	CPIA quality of public administration rating
Health	~~SP.DYN.LE00.IN~~	~~Life expectancy at birth, total (years)~~
Health	~~SP.DYN.IMRT.IN~~	~~Mortality rate, infant (per 1,000 live births)~~
Health	SH.MMR.RISK	Lifetime risk of maternal death (1 in: rate varies by country)
Health	SH.MLR.INCD.P3	Incidence of malaria (per 1,000 population at risk)
Health	SH.STA.SMSS.RU.ZS	People using safely managed sanitation services, rural
Health	~~SH.HIV.INCD~~	~~Adults (ages 15-49) newly infected with HIV~~
Health	SH.H2O.BASW.ZS	People using at least basic drinking water services (% of population)
Health	SH.IMM.HEPB	Immunization, HepB3 (% of one-year-old children)
Health	SH.IMM.MEAS	Immunization, measles (% of children ages 12-23 months)
Health	~~SH.IMM.IDPT~~	~~Immunization, DPT (% of children ages 12-23 months)~~
Health	~~SH.DTH.MORT~~	~~Number of under-five deaths~~
Health	SH.DTH.NMRT	Number of neonatal deaths
Education	SE.COM.DURS	Compulsory education, duration (years)
Education	NY.ADJ.AEDU.GN.ZS	Adjusted savings: education expenditure (% of GNI)
Education	SE.PRM.ENRR	School enrollment, primary (% gross)
Education	~~SE.PRE.ENRR~~	~~School enrollment, preprimary (% gross)~~
Education	SE.XPD.TERT.ZS	Expenditure on tertiary education
Education	SE.XPD.PRIM.ZS	Expenditure on primary education
Technology	IT.MLT.MAIN	Fixed telephone subscriptions
Technology	TM.VAL.OTHR.ZS.WT	Computer, communications and other services
Technology	BM.GSR.TRAN.ZS	Transport services (% of service imports, BoP)
Technology	~~EG.ELC.ACCS.RU.ZS~~	~~Access to electricity, rural (% of rural population)~~
Technology	EG.ELC.ACCS.ZS	Access to electricity (% of population)

The criteria used to omit these predictors is based on two main principles. The correlation matrix is first examined to identify the strongest Pearson correlations among the independent variables. Some variables are perfectly correlated, which is the first priority in omission. Predictors that are highly correlated with **several** other predictors are immediately removed. For example, the

association between the total population in Kenya and all other predictors in the economic model produce a correlation coefficient of above 0.9. This variable, as well as the other ones that were removed, are responsible for a significant amount of multicollinearity in the model. Removing, even just a few of these predictors, drastically improves each models correspondence to this condition. Variables were also eliminated intuitively. For example, it is not necessary to keep variables like rural access to electricity when Kenya's general access to electricity captures the same information. The CPIA gender equality is most likely captured in or related to the CPIA policies for social inclusion/equity cluster average. These predictors are omitted conservatively so that as long as the models can be applied to functions without producing an error or missing values, the Genetic Algorithm can be applied to help further resolve this issue.

After omission of the predictors in Table 5, here are the economic, political, health, education, and technology models that will be applied to the genetic algorithm, respectively.

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(BM.KLT.DINV.WD.GD.ZS) + \hat{\beta_2}(PA.NUS.FCRF) \tag{1}$$

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(\text{time}) + \hat{\beta_2}(\text{CC.EST}) + \hat{\beta_3}(\text{IQ.CPA.ENVR.XQ}) + \hat{\beta_4}(\text{IQ.CPA.SOCI.XQ}) + \hat{\beta_5}(\text{IQ.CPA.PADM.XQ}) \tag{2}$$

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(\text{time}) + \hat{\beta_2}(\text{SH.MLR.INCD.P3}) + \hat{\beta_3}(\text{SH.STA.SMSS.RU.ZS}) + \hat{\beta_4}(\text{SH.IMM.HEPB}) + \hat{\beta_5}(\text{SH.IMM.MEAS}) + \hat{\beta_6}(\text{SH.DTH.NMRT}) \tag{3}$$

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(\text{time}) + \hat{\beta_2}(\text{SE.COM.DURS}) + \hat{\beta_3}(\text{NY.ADJ.AEDU.GN.ZS}) + \hat{\beta_4}(\text{SE.PRM.ENRR}) + \hat{\beta_5}(\text{SE.XPD.TERT.ZS}) + \hat{\beta_6}(\text{SE.XPD.PRIM.ZS}) \tag{4}$$

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(\text{time}) + \hat{\beta_2}(\text{IT.MLT.MAIN}) + \hat{\beta_3}(\text{TM.VAL.OTHR.ZS.WT}) + \hat{\beta_4}(\text{BM.GSR.TRAN.ZS }) + \hat{\beta_5}(\text{EG.ELC.ACCS.ZS}) + \tag{5}$$

Note: Each model includes time in years as an additional predictor.

7.1 Residuals

Next, the assumptions for the residuals are examined. Results and commentary on the residual characteristics before the Genetic Algorithm is applied are shown in the Appendix section of the report. This section is based on **Models 1-5**.

Here are the properties that are acknowledged:

- Error terms must be uncorrelated with constant variance ($cov(\epsilon_i, \epsilon_k) = \sigma_{ik} I$)
- Error terms must be normally distributed ($\epsilon \sim \mathsf{N}(0, 1)$)

8 The Genetic Algorithm

The Genetic Algorithm is a problem-solving technique inspired by the principal of natural selection. Through this approach, iterative subsets of a population are created based off an arbitrary 'fitness' value. Candidates with stronger 'fitness' are more-likely to reproduce and the process converges to **one optimal solution.** The Genetic Algorithm is used in a variety of settings, such as machine learning and artificial intelligence. In this case, the Genetic Algorithm is used to produce a subset of the strongest model. The measure of fitness chosen for this analysis is the **Bayesian Information Criterion (BIC).** The BIC contains a high penalty, and as a result does not tend to favor complex models in the same way AIC and R^2 does. This characteristic sets BIC values apart from other measures of fitness and is therefore an ideal choice for producing the best model.

8.1 Fitness Evolution

The Fitness Evolution represents the negative BIC/fitness values corresponding to each of the iterations in the Genetic Algorithm. For visual demonstrations of this process, reference the "Fitness Evolution Plots" in the Appendix section of the report. The function for the Genetic Algorithm maximizes the fitness value regardless of how it is defined. Ideal BIC values are smaller, hence why the BIC is negated in the fitness function. As a result, the fitness evolution is based on the **negative of the** BIC.

8.2 Solution

The GA function in R returns a a binary string that assigns a '1' to variables that are selected and '0' to variables excluded from the model. This is considered the "solution" to the Genetic Algorithm. The function is also defaulted at an initial population of 50 models that are randomly selected. 100 generations occur to choose the final model. The probability of two models crossing over to mutate into the next generation (crossover) is set to 80%. The probability of a model changing from one iteration to the next (mutation) is set to 10%.

Note: The summary of the Genetic Algorithm applied to each model is located in the Appendix. The Genetic Algorithm produced these multivariate models:

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(BM.KLT.DINV.WD.GD.ZS) + \hat{\beta_2}(PA.NUS.FCRF) \tag{6}$$

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(\text{time}) + \hat{\beta_2}(\text{CC.EST}) + \hat{\beta_3}(\text{IQ.CPA.ENVR.XQ}) + \hat{\beta_4}(\text{IQ.CPA.SOCI.XQ}) + \hat{\beta_5}(\text{IQ.CPA.PADM.XQ}) \tag{7}$$

$$\hat{y_i} = \hat{\beta_0} + \hat{\beta_1}(\text{time}) + \hat{\beta_2}(\text{SH.MLR.INCD.P3}) + \hat{\beta_3}(\text{SH.STA.SMSS.RU.ZS}) + \hat{\beta_4}(\text{SH.DTH.NMRT}) \tag{8}$$

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1(\text{time}) + \hat{\beta}_2(\text{SE.COM.DURS}) + \hat{\beta}_3(\text{NY.ADJ.AEDU.GN.ZS}) + \hat{\beta}_4(\text{SE.PRM.ENRR}) \quad (9)$$

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1(\text{time}) + \hat{\beta}_2(\text{IT.MLT.MAIN}) + \hat{\beta}_3(\text{TM.VAL.OTHR.ZS.WT}) + \hat{\beta}_4(\text{BM.GSR.TRAN.ZS }) + \hat{\beta}_5(\text{EG.ELC.ACCS.ZS}) + \quad (10)$$

Note: The multiple regression results after applying the genetic algorithm are located in the appendix.

9 Results

9.1 Multivariate Analysis of Variance (MANOVA)

In this section, a Multivariate Analysis of Variance is used to examine the significance of the predictors on all nine of the response variables simultaneously. The results of the MANOVA are based on the null hypothesis that the coefficients of all predictors are zero. In other words, the MANOVA tests against the assumption that all independent variables in each model have no effect on the nine response variables. Larger F-statistics and smaller p-values indicate that the variables have an effect on these women empowerment indicators and are therefore significant in the multivariate analysis.

The economic variables that share a significant relationship with the nine women empowerment indicators are Foreign direct investment, net outflows (% of GDP) and Official exchange rate (LCU per US$, period average).

MANOVA Results for Economic Model

```
Type II MANOVA Tests: Pillai test statistic
                     Df test stat approx F num Df den Df    Pr(>F)
BM.KLT.DINV.WD.GD.ZS  1   0.77205    4.140      9     11   0.01513 *
PA.NUS.FCRF           1   0.97602   49.756      9     11 1.237e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The political variables that share a significant relationship with the nine women empowerment indicators are CPIA policy and institutions for environmental sustainability rating (1=low to 6=high), CPIA policies for social inclusion/equity cluster average (1=low to 6=high), and time.

MANOVA Results for Political Model

```
Type II MANOVA Tests: Pillai test statistic
               Df test stat approx F num Df den Df    Pr(>F)
CC.EST          1   0.72879    2.090      9      7  0.171712
PV.EST          1   0.65264    1.461      9      7  0.315524
IQ.CPA.ENVR.XQ  1   0.88239    5.836      9      7  0.014889 *
IQ.CPA.SOCI.XQ  1   0.89860    6.892      9      7  0.009294 **
IQ.CPA.PADM.XQ  1   0.41758    0.558      9      7  0.796290
time            1   0.99733  290.863      9      7 3.623e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The health-related variables that share a significant relationship with the nine women empowerment indicators are immunization, measles (% of children ages 12-23 months), number of neonatal deaths, and time.

MANOVA Results for Health Model

```
Type II MANOVA Tests: Pillai test statistic
            Df test stat approx F num Df den Df    Pr(>F)
SH.IMM.HEPB  1   0.54438      1.2      9      9   0.39763
SH.IMM.MEAS  1   0.80921      4.2      9      9   0.02127 *
SH.DTH.NMRT  1   0.99978   4472.1      9      9 2.472e-15 ***
time         1   0.99761    417.1      9      9 1.052e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The education-related variables that share a significant relationship with the nine women empowerment indicators are compulsory education, duration (years), adjusted savings: education expenditure (% of GNI), and time.

MANOVA Results for Education Model

```
Type II MANOVA Tests: Pillai test statistic
                  Df test stat approx F num Df den Df    Pr(>F)
SE.COM.DURS        1   0.84057     5.27      9      9 0.0105097
NY.ADJ.AEDU.GN.ZS  1   0.93594    14.61      9      9 0.0002339
SE.PRM.ENRR        1   0.71845     2.55      9      9 0.0895387
time               1   0.99686   317.09      9      9 3.595e-10

SE.COM.DURS       *
NY.ADJ.AEDU.GN.ZS ***
SE.PRM.ENRR       .
time              ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The technology-related variables that share a significant relationship with the nine women empowerment are fixed telephone subscriptions, transport services (% of service imports, BoP), Access to electricity (% of population), and time.

MANOVA Results for Technology Model

```
Type II MANOVA Tests: Pillai test statistic
                  Df test stat approx F num Df den Df    Pr(>F)
IT.MLT.MAIN        1   0.92024   10.256      9      8  0.001616 **
TM.VAL.OTHR.ZS.WT  1   0.55574    1.112      9      8  0.445871
BM.GSR.TRAN.ZS     1   0.83092    4.368      9      8  0.024817 *
EG.ELC.ACCS.ZS     1   0.79612    3.471      9      8  0.046905 *
time               1   0.99526  186.499      9      8 2.512e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

9.2 Significance of Predictors

The heat maps below in **Figures** , visually demonstrate the significance of each of the predictors on the nine response variables. Darker, more pigmented segments indicate stronger significance, whereas lighter shadings indicate a lack of significance. These maps are fairly consistent with the results of the MANOVA in the previous section.

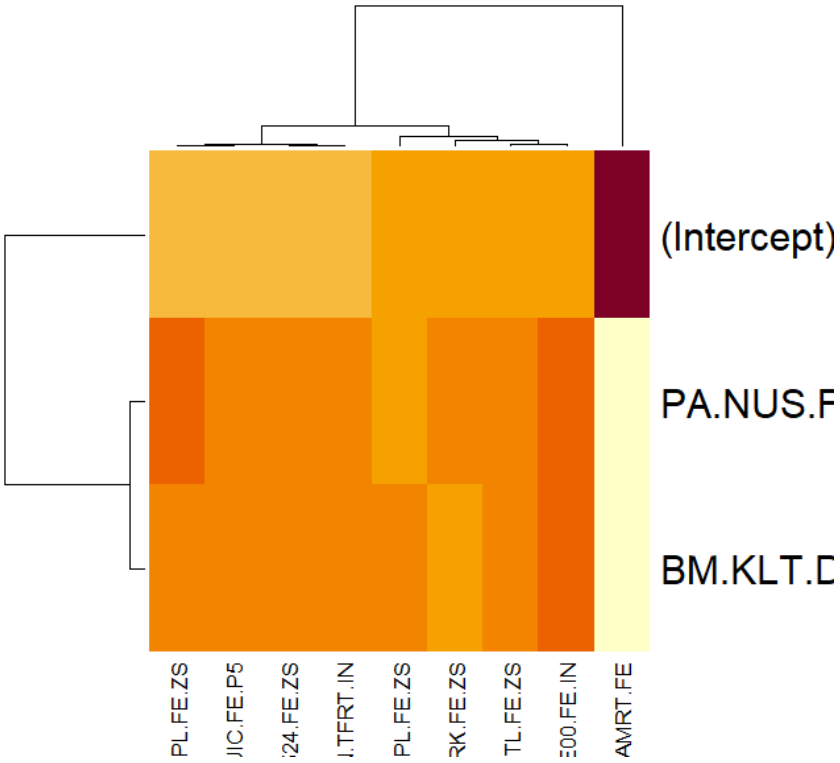

Figure 23: Heat Map for Economic Model

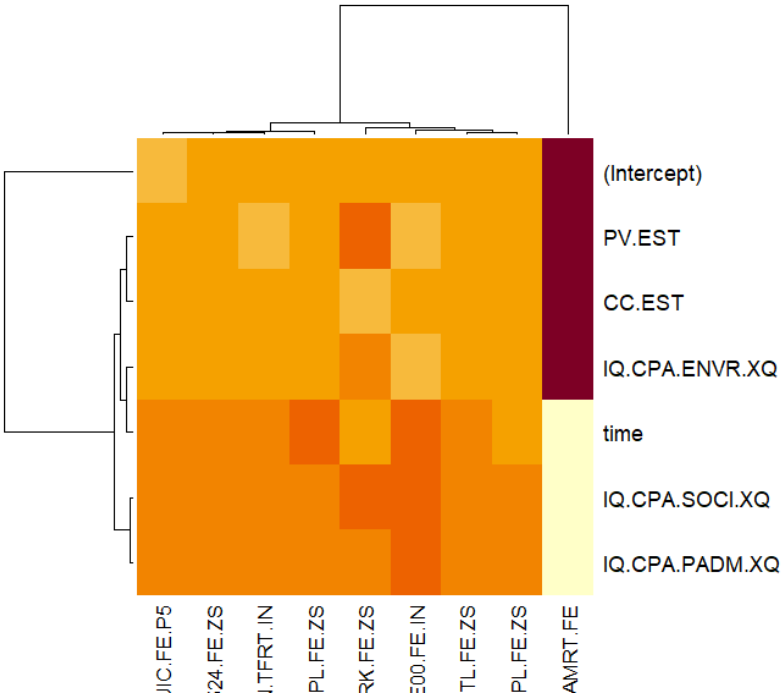

Figure 24: Heat Map for Political Model

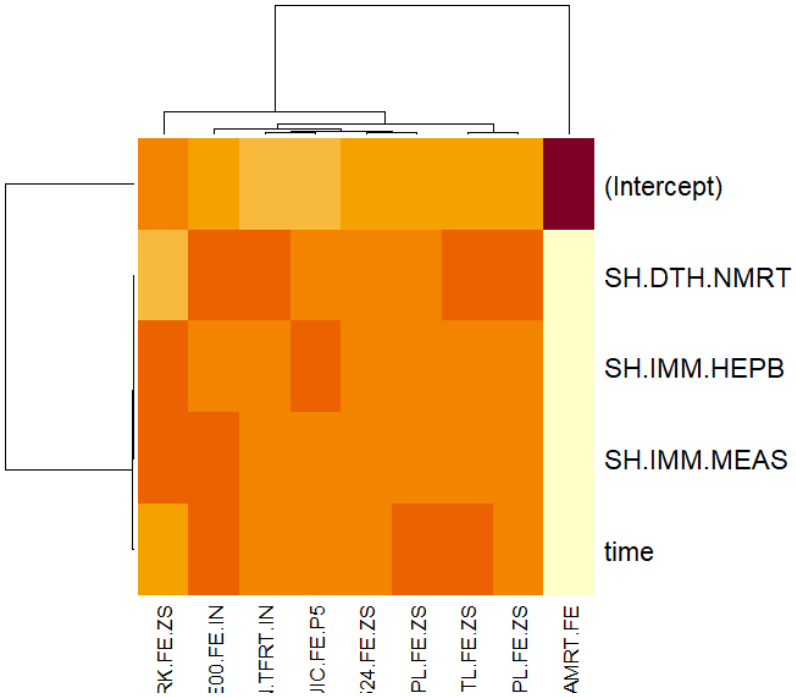

Figure 25: Heat Map for Health Model

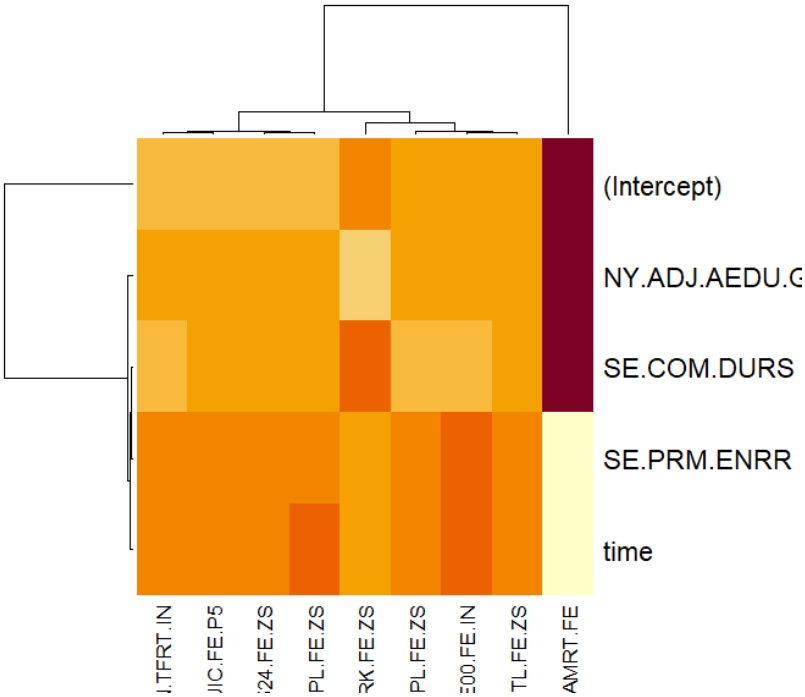

Figure 26: Heat Map for Education Model

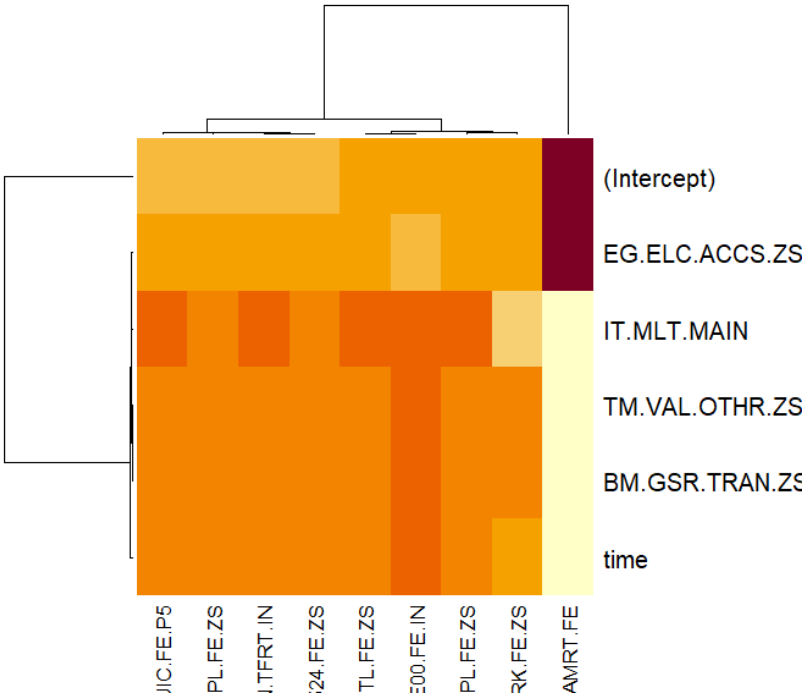

Figure 27: Heat Map for Technology Model

9.3 Predictions

The predictions for fertility rate, female mortality rate, incidence of HIV in women, percent of female population, female life expectancy, women employed in agriculture, women employed in industry, female contributing family members, and female suicides are shown in **Tables 6 through 10** in this respective order. Predictions are made for the year 2022 and are calculated based off the values of the predictors in this same year or the most current year. Models do not have predictions if none of the variables are significant. These results can be compared to the actual women empowerment indicators in 2022 shown in **Figure 11.**

Table 6: Women Empowerment Predictions (Part 1), Year 2022

	Economic Model	**Political Model**	**Health Model**
Fertility Rate	2.951521	3.302742	3.175857
Mortality Rate	262.939822	266.212000	280.945231
HIV Incidence	1.696182	1.687013	1.764471
Female Population	50.419316	-	50.419316
Life Expectancy	67.468817	67.169467	66.215928
Agriculture Employment	31.416582	33.398182	33.398182
Industry Employment	10.966687	10.351732	10.668767
Family Workers	28.390737	26.720403	28.295611
Suicide Rate	2.681278	2.681278	2.681278

Table 7: Women Empowerment Predictions (Part 2), Year 2022

	Education Model	**Technology Model**
Fertility Rate	3.235805	3.207088
Mortality Rate	266.212000	-
HIV Incidence	1.443599	1.684217
Female Population	50.419316	-
Life Expectancy	67.169467	67.289677
Agriculture Employment	33.398182	33.398182
Industry Employment	10.351732	10.259719
Family Workers	24.866007	26.695655
Suicide Rate	2.681278	2.681278

Table 8: Women Empowerment Actual Values, Year 2022

	Actual
Fertility Rate	3.235805
Mortality Rate	266.212000
HIV Incidence	1.443599
Female Population	50.419316
Life Expectancy	67.169467
Agriculture Employment	33.398182
Industry Employment	10.351732
Family Workers	24.866007
Suicide Rate	2.681278

It appears the the health model seems to contain the most accurate predictions, but it is hard to say, since information is limited.

9.4 Relationships Between Responses

As one would expect, the relationships across most of the women empowerment indicators appear to be linear and very strongly associated based on the correlation plot in **Figure 33.** The relationships that appear weak and insignificant (linear) are between female percentage of population and each of the remaining response variables. This may suggest a possible quadratic association between female percentage of population and the other 8 response variables that is not being detected with correlation.

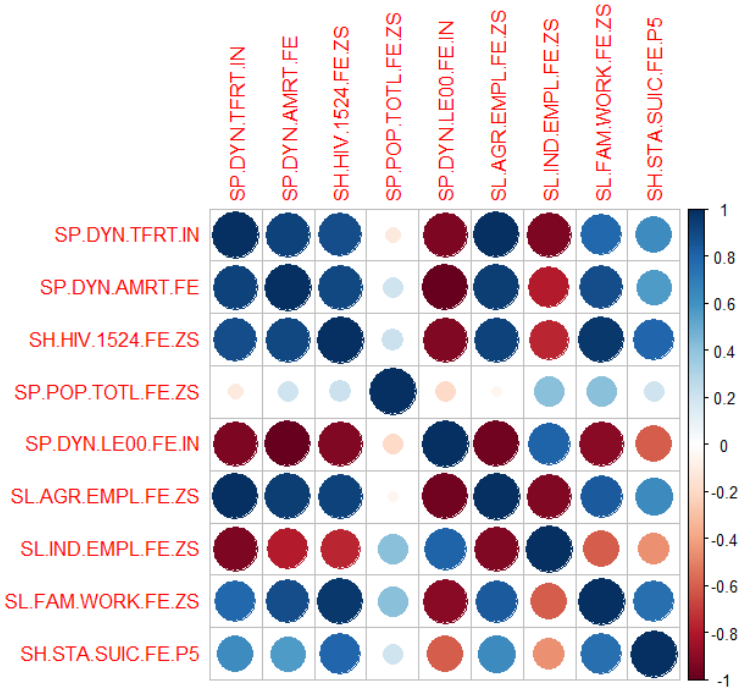

Figure 28: Correlation Plot of Women Empowerment Indicators

10 Diagnostics

This section begins with an examination of the residuals produced by the models.

10.1 Uncorrelated/Independent Residuals:

Based on the Residuals versus Observation Order plot in **Figure 34**, the models appear to have highly correlated residuals, since the residuals are following trends and "fanning out", especially in the technology model. The variance of the residuals seems to increase with observation order. The Durbin-Watson test detected auto-correlation in the residuals, therefore this assumption has been violated for all 5 models.

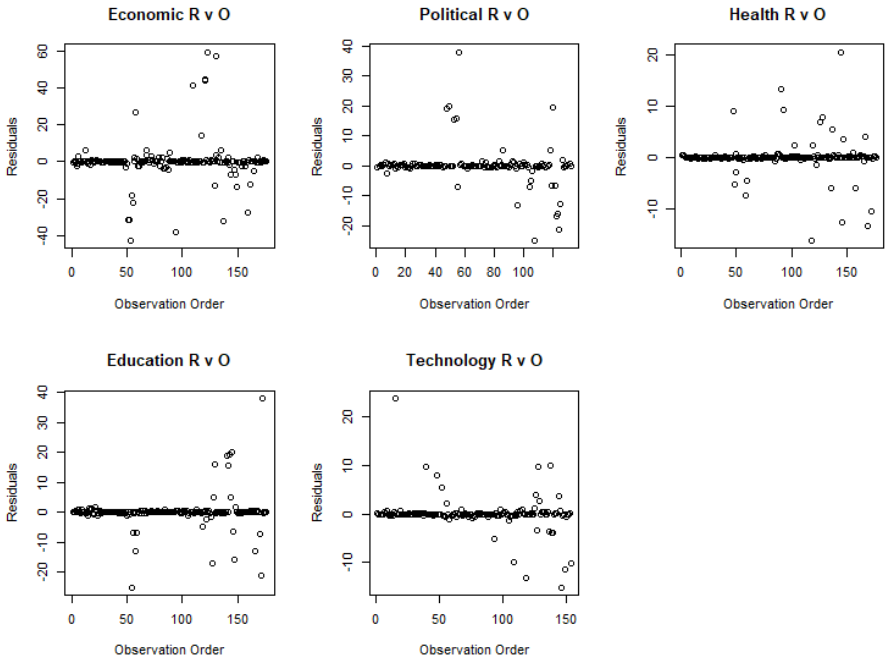

Figure 29: Plots of Residual versus Order after Genetic Algorithm

Table 9: Summary of Durbin-Watson Test

Model	Durbin-Watson Statistic (DW)	p-value
Economic	0.43348	5.653×10^{-8}
Political	0.48085	2.157×10^{-7}
Health	1.3191	0.006315
Education	0.45366	8.723×10^{-8}
Technology	0.45366	8.723×10^{-8}

10.2 Principal Components and Bi-plots of Residuals

The bi-plots of the principal components of the residuals in all five models are shown in **Figure 35** These plots can further demonstrate the source of these auto-correlated residuals.

Economic Model Bi-plot: The loadings of the first and second principal components in the economic model show that the residuals of fertility, agriculture employment, mortality, HIV prevalence, population, and suicide rates are positively correlated, while life expectancy and industry employment are positively correlated.

Political Model Bi-plot: The loadings of the first and second principal components in the political model show that the residuals of fertility, agriculture employment, mortality, and HIV prevalence are positively correlated, while life expectancy and industry employment are positively correlated.

Health Model Bi-plot: The loadings of the first and second principal components in the health model show that the residuals of fertility, agriculture employment, industry employment, mortality, HIV prevalence, population, suicide rates, and contributing family workers are positively correlated, while life expectancy appears uncorrelated with the rest.

Education Model Bi-plot: The loadings of the first and second principal components in the education model show that the residuals of industry employment, population, mortality, and agriculture employment are positively correlated. These variables are negatively correlated with the residuals of life expectancy. The residuals for fertility and suicide rates are positively correlated.

Technology Model Bi-plot: The loadings of the first and second principal components in the technology model show that the residuals of mortality and agriculture employment, as well as population, HIV prevalence, and industry employment are positively correlated. The residuals for fertility and life expectancy appear independent.

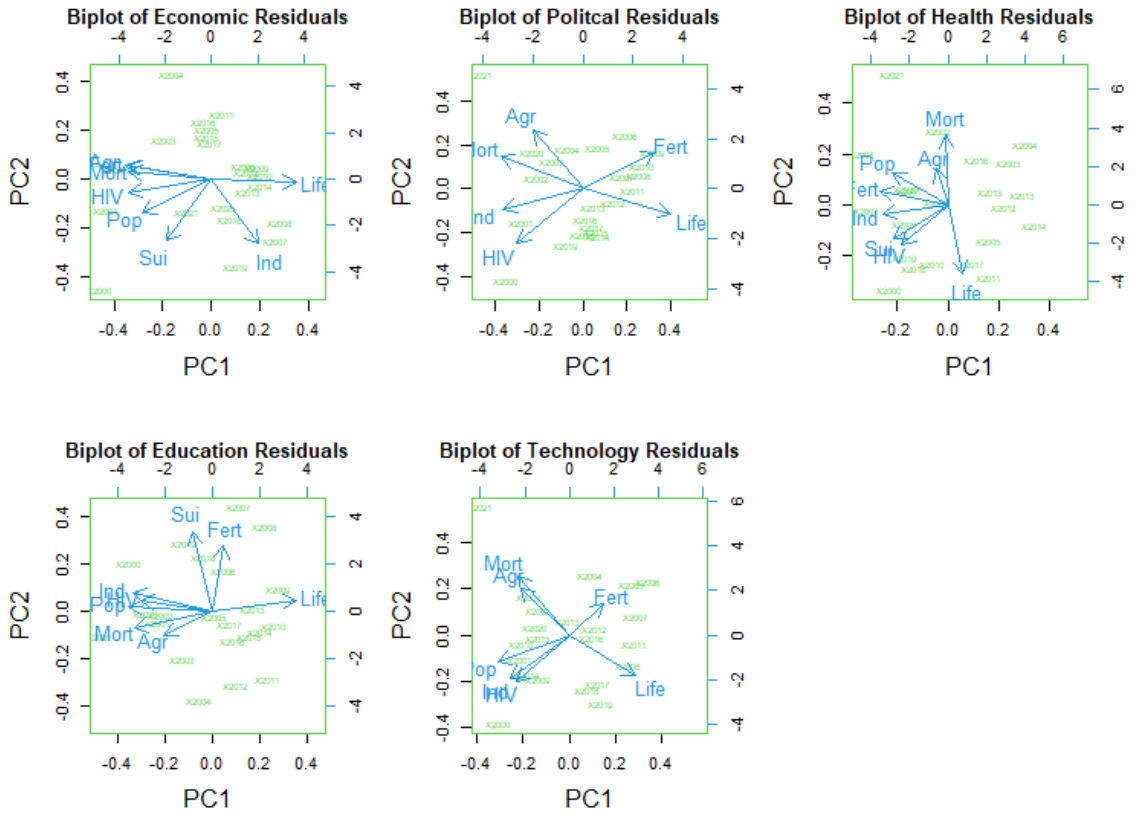

Figure 30: Bi-Plots of Residuals after Genetic Algorithm

10.3 Constant Variance

The plots of the Residuals versus Fitted Values in **Figure 36** demonstrate unequal variance in the residuals of the five models. The variance of the residuals drastically increase with larger fitted values.

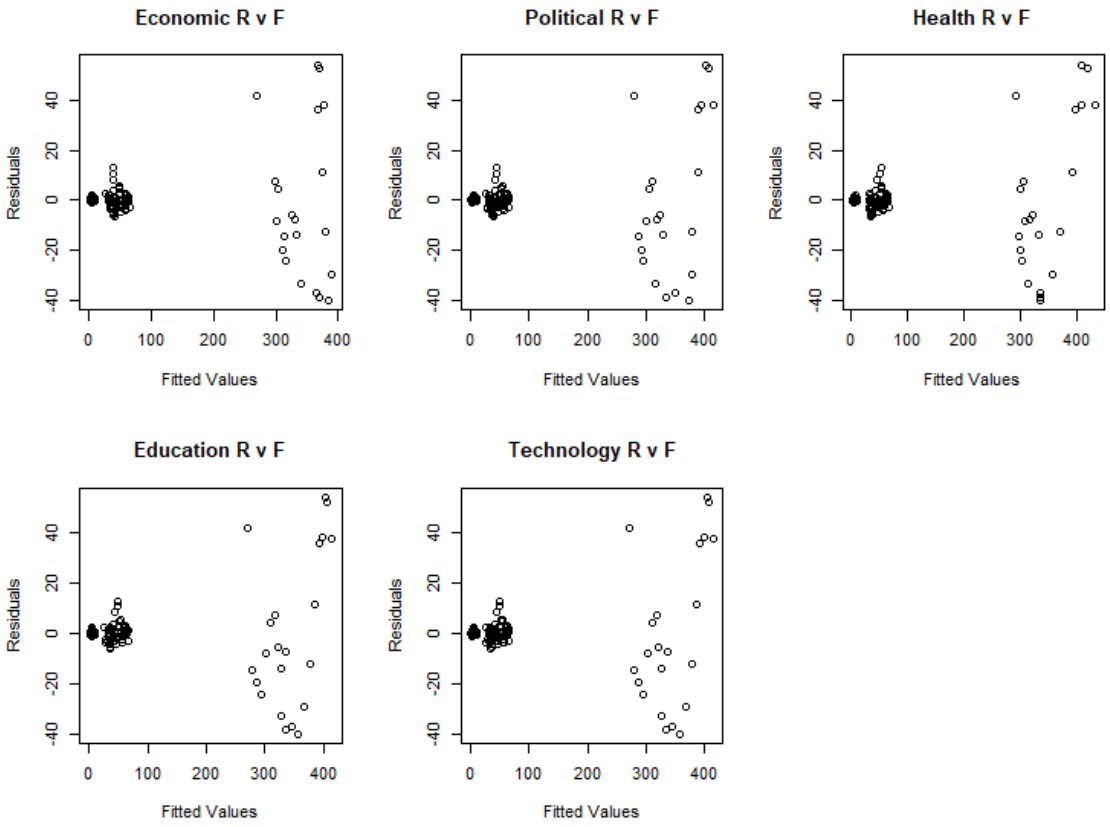

Figure 31: Plots of Residuals versus Fitted Values after Genetic Algorithm

10.4 Normality

i. Univariate Normality:

The residuals for the five models do not appear to follow a univariate normal distribution as shown in the Normal Probability Plots in **Figure 37.**

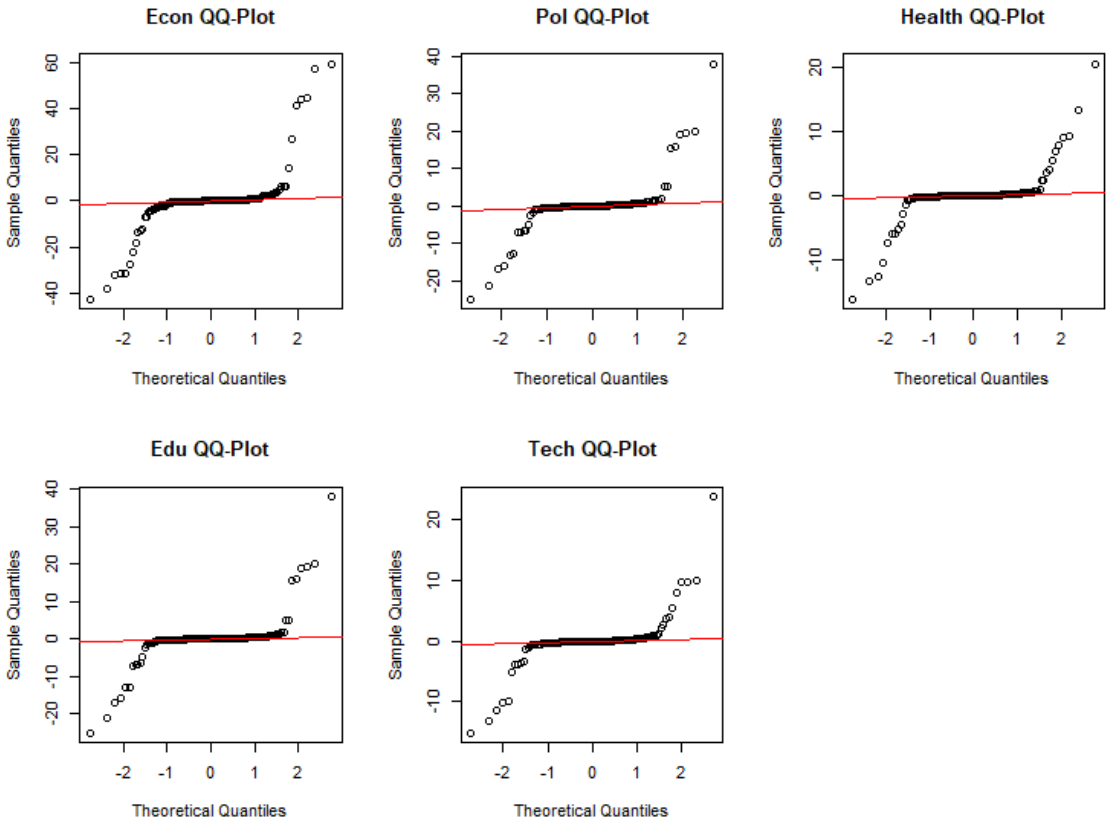

Figure 32: Normal Q-Q Plots of Residuals after Genetic Algorithm

ii. Multivariate Normality:

The multivariate normal probability plots in **Figure 38** exhibit a few observations in each model that could be worsening the residuals correspondence to the normality condition. The observations with the largest Mahalanobis distances were removed before performing the Multivariate Shapiro-Wilk Test for Multivariate Normality. These omitted values did not remedy the violation to the multivariate normality condition for the residuals. According to the Shapiro-Wilk test, the residuals for the five multivariate models are not normally distributed.

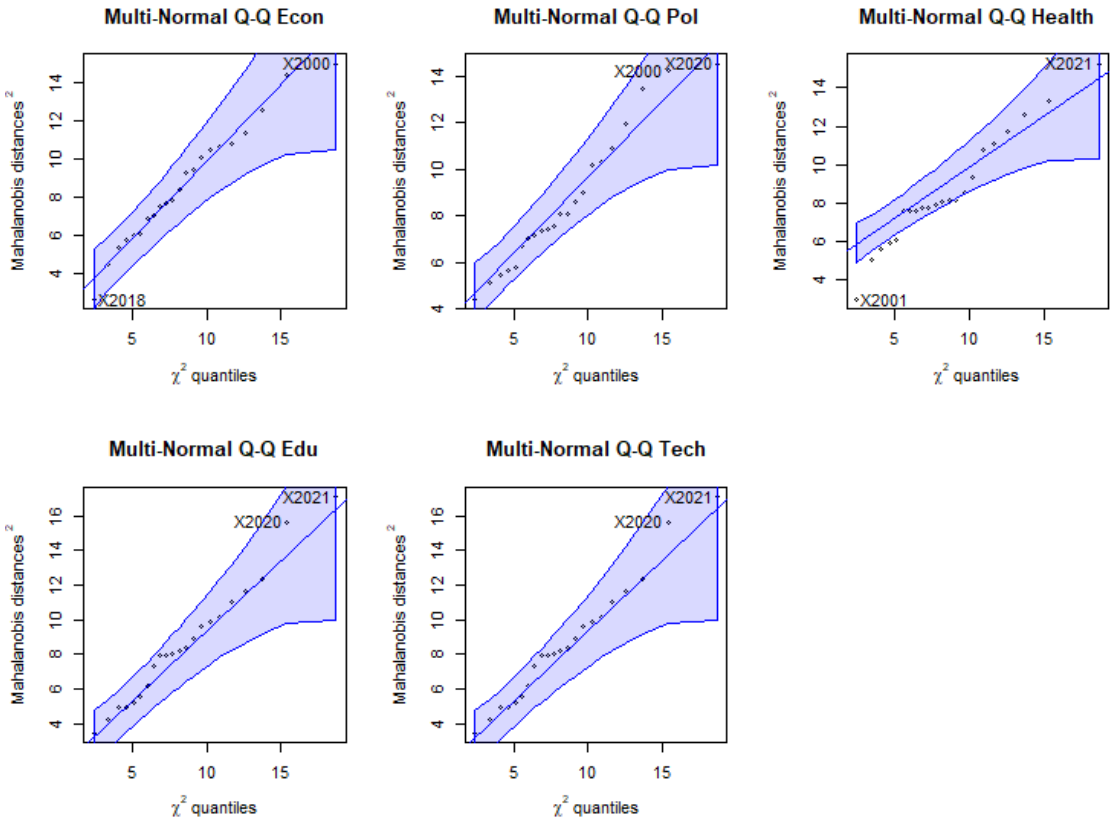

Figure 33: Multivariate Normal Q-Q Plots of Residuals after Genetic Algorithm

Table 10: Summary of Multivariate Shapiro-Wilk Test for Normality

Model	**Shapiro-Wilk Statistic (W)**	**p-value**
Economic	0.52399	$< 2.2 \times 10^{-16}$
Political	0.55345	$< 2.2 \times 10^{-16}$
Health	0.49256	$< 2.2 \times 10^{-16}$
Education	0.4683	$< 2.2 \times 10^{-16}$
Technology	0.50898	$< 2.2 \times 10^{-16}$

10.5 Model Performance

The *BIC* values of the five models are shown in **Table 14.** The model with the lowest *BIC* value, and therefore the strongest fitness is the health model.

Table 11: Model Fitness Values (BIC)

	BIC Values
Economic Model	1504.8805
Political Model	1082.9308
Health Model	787.9473
Education Model	1105.1146
Technology Model	1025.7301

11 Conclusions and Discussion

The Genetic Algorithm is an adequate approach for variable selection in both multivariate and multiple regression, as it optimizes model fitness, while considering a population of all models. This approach is mostly beneficial when navigating large data sets. Although ideal for model selection, there are several drawbacks to this approach. When applied to a data set with volatile conditions, the genetic algorithm may not provide a solution to model assumptions. For example, multi-collinearity can grow in the Genetic Algorithm process if highly-correlated variables are not removed at the start of the analysis. This is is because fitness values, such as AIC, BIC, and R^2 can increase with predictor collinearity and correlated residuals. It is important to note that, because of these drawbacks and the many violations to the regression models, inferences on the final models are not reliable. Because of this, these conclusions are made with extreme caution.

The significance of the predictors and details of models are noted in previous sections of the paper. As mentioned before, the raw results of the multiple regression analysis are shown in the appendix section. According to both the BIC values and the accuracy of the predictions, the health model seemed to significantly outperform the remaining four.

Multivariate regression is a great approach when wanting to learn information about several response variables simultaneously. In Multivariate Regression, Comparisons, predictions, and inferences can be made using *one model*. This is important when working with large data and real-life as less relationships can be neglected with this approach.

Although, many assumptions are not met and information is limited in the final models, this is a great start to a deep-dive into political applications of statistics in Kenya. These models can be used to paint a picture of women's experience in Kenya and across the world. In the future, it might be best to consider another approach, since regression analysis is more limiting and sensitive. There are many conditions to be accounted for that are not met by this analysis. Perhaps a more Bayesian would be acceptable.

12 References

1. Fox, J., & Weisberg, S. "Multivariate Linear Models in R: An Appendix to An R Companion to Applied Regression, Third Edition."

2. Johnson, R.A., & Wichern, D.W. *Applied Multivariate Statistical Analysis*. 5th ed., Pearson, 2002. Chapter 7: Multivariate Linear Regression Models.

3. Macrotrends. "Global Metrics." Available at: `https://www.macrotrends.net/global-metrics`.

4. Mathew, T.V. *Genetic Algorithm*. Indian Institute of Technology Bombay, Mumbai-400076. Department of Civil Engineering.

5. Scrucca, L. "Package 'GA'." Version 3.2.4, 2024. Available at: `https://cran.r-project.org/web/packages/GA/`.

6. The Comprehensive R Archive Network (CRAN). Available at: `https://cran.r-project.org/`.

7. University of Virginia Library. "Getting Started with Multivariate Multiple Regression."

8. World Bank. "Kenya Data." Available at: `https://data.worldbank.org/country/kenya`.

9. Yeniay, Ö., & Göktaş, A. "A Genetic Algorithm Approach for the Best Subset Selection in Linear Regression." *Gazi University Journal of Science*, vol. 16, no. 1, 2010, pp. 37-45. Available at: `https://dergipark.org.tr/en/pub/gujs/issue/7406/97063`.

10. Zelterman, D. *Applied Multivariate Statistics with R*. Springer, 2015. Chapter 9: Multivariable Linear Regression.

13 Appendix

13.1 Results of Multiple Regression Prior to Genetic Algorithm

Table 12: Summary of Economic Model

```
> summary(econ.m)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ (time + BM.KLT.DINV.WD.GD.ZS +
    SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
    PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
    SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
    time - NE.EXP.GNFS.CD, data = cbind(time, econ))

Residuals:
     Min       1Q   Median       3Q      Max
-0.35874 -0.20609 -0.00552  0.15971  0.44164

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           7.822005   0.373036  20.969 1.35e-14 ***
BM.KLT.DINV.WD.GD.ZS -0.624750   0.403071  -1.550    0.138
PA.NUS.FCRF          -0.040383   0.004341  -9.303 1.66e-08 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2552 on 19 degrees of freedom
Multiple R-squared:  0.8369,  Adjusted R-squared:  0.8198
F-statistic: 48.76 on 2 and 19 DF,  p-value: 3.29e-08


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ (time + BM.KLT.DINV.WD.GD.ZS +
    SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
    PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
    SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
    time - NE.EXP.GNFS.CD, data = cbind(time, econ))

Residuals:
    Min      1Q  Median      3Q     Max
-40.029 -23.167  -7.878  29.983  54.041

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           560.001     47.353  11.826 3.31e-10 ***
```

```
BM.KLT.DINV.WD.GD.ZS  -70.504     51.166  -1.378 0.184234
PA.NUS.FCRF            -2.414      0.551  -4.382 0.000321 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 32.4 on 19 degrees of freedom
Multiple R-squared:  0.5594,  Adjusted R-squared:  0.513
F-statistic: 12.06 on 2 and 19 DF,  p-value: 0.0004153


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ (time + BM.KLT.DINV.WD.GD.ZS +
    SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
    PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
    SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
    time - NE.EXP.GNFS.CD, data = cbind(time, econ))

Residuals:
     Min       1Q   Median       3Q      Max
-1.02839 -0.58845 -0.03671  0.21830  2.29794

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           8.57397    1.26427   6.782 1.78e-06 ***
BM.KLT.DINV.WD.GD.ZS -1.51241    1.36607  -1.107  0.28206
PA.NUS.FCRF          -0.05608    0.01471  -3.812  0.00118 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.865 on 19 degrees of freedom
Multiple R-squared:  0.4852,  Adjusted R-squared:  0.431
F-statistic: 8.954 on 2 and 19 DF,  p-value: 0.001822


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ (time + BM.KLT.DINV.WD.GD.ZS +
    SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
    PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
    SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
    time - NE.EXP.GNFS.CD, data = cbind(time, econ))

Residuals:
      Min        1Q    Median        3Q       Max
-0.069352 -0.019672 -0.006209  0.009123  0.086599
```

```
92
93  Coefficients:
94                          Estimate Std. Error t value Pr(>|t|)
95  (Intercept)           50.1927125  0.0601896 833.910   <2e-16 ***
96  BM.KLT.DINV.WD.GD.ZS -0.1492739  0.0650358  -2.295   0.0333 *
97  PA.NUS.FCRF           0.0019775  0.0007004   2.823   0.0109 *
98  ---
99  Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
              1
100
101 Residual standard error: 0.04118 on 19 degrees of freedom
102 Multiple R-squared:  0.3717,  Adjusted R-squared:  0.3056
103 F-statistic:  5.62 on 2 and 19 DF,  p-value: 0.01209
104
105
106 Response SP.DYN.LE00.FE.IN :
107
108 Call:
109 lm(formula = SP.DYN.LE00.FE.IN ~ (time + BM.KLT.DINV.WD.GD.ZS +
110     SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
111     PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
112     SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
113     time - NE.EXP.GNFS.CD, data = cbind(time, econ))
114
115 Residuals:
116     Min      1Q  Median      3Q     Max
117 -3.8350 -1.8546  0.5683  1.5539  2.8586
118
119 Coefficients:
120                      Estimate Std. Error t value Pr(>|t|)
121 (Intercept)          45.21451    3.35808  13.464 3.62e-11 ***
122 BM.KLT.DINV.WD.GD.ZS  5.07361    3.62846   1.398  0.17814
123 PA.NUS.FCRF           0.18118    0.03908   4.637  0.00018 ***
124 ---
125 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
              1
126
127 Residual standard error: 2.297 on 19 degrees of freedom
128 Multiple R-squared:  0.5845,  Adjusted R-squared:  0.5408
129 F-statistic: 13.37 on 2 and 19 DF,  p-value: 0.0002377
130
131
132 Response SL.AGR.EMPL.FE.ZS :
133
134 Call:
135 lm(formula = SL.AGR.EMPL.FE.ZS ~ (time + BM.KLT.DINV.WD.GD.ZS +
136     SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
137     PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
138     SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
139     time - NE.EXP.GNFS.CD, data = cbind(time, econ))
```

```
140
141 Residuals:
142     Min      1Q  Median      3Q     Max
143 -4.5272 -2.2365  0.1002  1.8083  5.4704
144
145 Coefficients:
146                       Estimate Std. Error t value Pr(>|t|)
147 (Intercept)           79.19967    4.57281  17.320 4.28e-13 ***
148 BM.KLT.DINV.WD.GD.ZS -5.98183    4.94100  -1.211    0.241
149 PA.NUS.FCRF           -0.39641    0.05321  -7.450 4.75e-07 ***
150 ---
151 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
152
153 Residual standard error: 3.129 on 19 degrees of freedom
154 Multiple R-squared:  0.7665,  Adjusted R-squared:  0.7419
155 F-statistic: 31.19 on 2 and 19 DF,  p-value: 9.967e-07
156
157
158 Response SL.IND.EMPL.FE.ZS :
159
160 Call:
161 lm(formula = SL.IND.EMPL.FE.ZS ~ (time + BM.KLT.DINV.WD.GD.ZS +
162     SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
163     PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
164     SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
165     time - NE.EXP.GNFS.CD, data = cbind(time, econ))
166
167 Residuals:
168      Min       1Q   Median       3Q      Max
169 -0.51002 -0.31930  0.01119  0.24204  0.68778
170
171 Coefficients:
172                        Estimate Std. Error t value Pr(>|t|)
173 (Intercept)            2.441394   0.543691   4.490 0.000251 ***
174 BM.KLT.DINV.WD.GD.ZS -0.462563   0.587467  -0.787 0.440769
175 PA.NUS.FCRF            0.073026   0.006327  11.543 4.98e-10 ***
176 ---
177 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
178
179 Residual standard error: 0.372 on 19 degrees of freedom
180 Multiple R-squared:  0.8767,  Adjusted R-squared:  0.8637
181 F-statistic: 67.53 on 2 and 19 DF,  p-value: 2.317e-09
182
183
184 Response SL.FAM.WORK.FE.ZS :
185
186 Call:
187 lm(formula = SL.FAM.WORK.FE.ZS ~ (time + BM.KLT.DINV.WD.GD.ZS +
```

```
    SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
    PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
    SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
    time - NE.EXP.GNFS.CD, data = cbind(time, econ))

Residuals:
    Min      1Q  Median      3Q     Max
-6.3033 -3.4557 -0.5933  1.9823 12.8351

Coefficients:
                       Estimate Std. Error t value Pr(>|t|)
(Intercept)            56.63767    8.05629   7.030 1.08e-06 ***
BM.KLT.DINV.WD.GD.ZS -12.36353    8.70495  -1.420   0.1717
PA.NUS.FCRF           -0.22106    0.09375  -2.358   0.0292 *
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 5.512 on 19 degrees of freedom
Multiple R-squared:  0.3242,  Adjusted R-squared:  0.253
F-statistic: 4.557 on 2 and 19 DF,  p-value: 0.02418


Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ (time + BM.KLT.DINV.WD.GD.ZS +
    SP.URB.TOTL + SP.RUR.TOTL + SP.POP.TOTL + NY.GDP.MKTP.CD +
    PA.NUS.FCRF + NE.EXP.GNFS.CD + TX.VAL.MRCH.WL.CD) - SP.POP.TOTL -
    SP.URB.TOTL - SP.RUR.TOTL - NY.GDP.MKTP.CD - TX.VAL.MRCH.WL.CD -
    time - NE.EXP.GNFS.CD, data = cbind(time, econ))

Residuals:
     Min       1Q   Median       3Q      Max
-0.64617 -0.13247 -0.02159  0.08728  0.99249

Coefficients:
                       Estimate Std. Error t value Pr(>|t|)
(Intercept)            4.532723   0.506483   8.949 3.05e-08 ***
BM.KLT.DINV.WD.GD.ZS -0.623361   0.547263  -1.139   0.2688
PA.NUS.FCRF          -0.014771   0.005894  -2.506   0.0215 *
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.3465 on 19 degrees of freedom
Multiple R-squared:  0.3196,  Adjusted R-squared:  0.248
F-statistic: 4.463 on 2 and 19 DF,  p-value: 0.02576

\end{listing}
```

```
> summary(pol.m)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
      Min        1Q    Median        3Q       Max
-0.092151 -0.025252 -0.006554  0.030691  0.109987

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     5.21280    0.48996  10.639 2.20e-08 ***
time           -0.08597    0.00549 -15.660 1.06e-10 ***
CC.EST          0.17590    0.19486   0.903   0.3809
PV.EST         -0.23920    0.13607  -1.758   0.0992 .
IQ.CPA.ENVR.XQ  0.13675    0.10630   1.286   0.2178
IQ.CPA.SOCI.XQ -0.32377    0.12028  -2.692   0.0167 *
IQ.CPA.PADM.XQ  0.16877    0.15174   1.112   0.2835
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.05842 on 15 degrees of freedom
Multiple R-squared:  0.9933,  Adjusted R-squared:  0.9906
F-statistic: 368.1 on 6 and 15 DF,  p-value: 2.083e-15


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
    Min      1Q  Median      3Q     Max
-16.246  -7.379  -3.610   7.541  16.934

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     727.108     97.373   7.467 1.99e-06 ***
time             -6.669      1.091  -6.113 1.98e-05 ***
CC.EST           63.367     38.724   1.636   0.1226
PV.EST           59.822     27.042   2.212   0.0429 *
IQ.CPA.ENVR.XQ   29.933     21.126   1.417   0.1770
IQ.CPA.SOCI.XQ  -33.163     23.903  -1.387   0.1856
```

```
IQ.CPA.PADM.XQ  -46.380     30.155  -1.538   0.1449
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 11.61 on 15 degrees of freedom
Multiple R-squared:  0.9553,  Adjusted R-squared:  0.9375
F-statistic: 53.46 on 6 and 15 DF,  p-value: 2.798e-09


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
    Min      1Q  Median      3Q     Max
-0.4605 -0.2662 -0.1489  0.2529  0.6944

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     3.92318    3.52296   1.114 0.282976
time           -0.17138    0.03947  -4.342 0.000581 ***
CC.EST         -2.78811    1.40105  -1.990 0.065138 .
PV.EST          2.65573    0.97840   2.714 0.015991 *
IQ.CPA.ENVR.XQ  0.48920    0.76436   0.640 0.531821
IQ.CPA.SOCI.XQ  0.32858    0.86482   0.380 0.709314
IQ.CPA.PADM.XQ -0.19923    1.09102  -0.183 0.857553
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.4201 on 15 degrees of freedom
Multiple R-squared:  0.9041,  Adjusted R-squared:  0.8658
F-statistic: 23.58 on 6 and 15 DF,  p-value: 7.794e-07


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
      Min        1Q    Median        3Q       Max
-0.051613 -0.031093  0.000221  0.027455  0.069292

```

```
Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)    51.147341   0.341493 149.776   <2e-16 ***
time            0.004201   0.003826   1.098   0.2896
CC.EST         -0.024467   0.135809  -0.180   0.8594
PV.EST          0.268901   0.094840   2.835   0.0125 *
IQ.CPA.ENVR.XQ  0.029730   0.074092   0.401   0.6939
IQ.CPA.SOCI.XQ -0.123766   0.083830  -1.476   0.1605
IQ.CPA.PADM.XQ -0.063532   0.105757  -0.601   0.5570
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.04072 on 15 degrees of freedom
Multiple R-squared:  0.515, Adjusted R-squared:  0.321
F-statistic: 2.654 on 6 and 15 DF,  p-value: 0.05856


Response SP.DYN.LE00.FE.IN :

Call:
lm(formula = SP.DYN.LE00.FE.IN ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
     Min       1Q   Median       3Q      Max
-1.08997 -0.43235  0.08706  0.41667  1.06964

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)    36.88945    5.99487   6.154 1.85e-05 ***
time            0.48557    0.06717   7.229 2.93e-06 ***
CC.EST         -2.83126    2.38411  -1.188   0.2535
PV.EST         -4.69575    1.66490  -2.820   0.0129 *
IQ.CPA.ENVR.XQ -2.18292    1.30068  -1.678   0.1140
IQ.CPA.SOCI.XQ  2.41321    1.47163   1.640   0.1218
IQ.CPA.PADM.XQ  2.78130    1.85655   1.498   0.1549
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.7148 on 15 degrees of freedom
Multiple R-squared:  0.9682,  Adjusted R-squared:  0.9555
F-statistic: 76.23 on 6 and 15 DF,  p-value: 2.212e-10


Response SL.AGR.EMPL.FE.ZS :

Call:
```

```
lm(formula = SL.AGR.EMPL.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
     Min       1Q   Median       3Q      Max
-0.39693 -0.15335  0.00222  0.08143  0.35661

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    55.21359    2.06911  26.685 4.67e-14 ***
time           -0.98589    0.02318 -42.527  < 2e-16 ***
CC.EST         -0.13515    0.82287  -0.164  0.87173
PV.EST          1.50305    0.57463   2.616  0.01948 *
IQ.CPA.ENVR.XQ  1.50415    0.44892   3.351  0.00438 **
IQ.CPA.SOCI.XQ  0.01188    0.50793   0.023  0.98164
IQ.CPA.PADM.XQ -0.88626    0.64078  -1.383  0.18688
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2467 on 15 degrees of freedom
Multiple R-squared:  0.9989,  Adjusted R-squared:  0.9984
F-statistic:  2178 on 6 and 15 DF,  p-value: < 2.2e-16


Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
    Min      1Q  Median      3Q     Max
-0.4058 -0.1934 -0.0052  0.1658  0.5385

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    12.54185    2.48863   5.040 0.000147 ***
time            0.17811    0.02788   6.388 1.22e-05 ***
CC.EST         -0.42683    0.98971  -0.431 0.672411
PV.EST          2.16805    0.69114   3.137 0.006786 **
IQ.CPA.ENVR.XQ  0.05250    0.53995   0.097 0.923824
IQ.CPA.SOCI.XQ -1.02684    0.61091  -1.681 0.113496
IQ.CPA.PADM.XQ -0.08697    0.77070  -0.113 0.911652
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

```

```
Residual standard error: 0.2967 on 15 degrees of freedom
Multiple R-squared:  0.938, Adjusted R-squared:  0.9133
F-statistic: 37.85 on 6 and 15 DF,  p-value: 3.15e-08


Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
    Min      1Q  Median      3Q     Max
-5.3441 -2.2942 -0.1508  2.3300  6.0945

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     55.1032    29.4888   1.869   0.0813 .
time            -0.9119     0.3304  -2.760   0.0146 *
CC.EST         -12.3942    11.7275  -1.057   0.3073
PV.EST          19.5773     8.1897   2.390   0.0304 *
IQ.CPA.ENVR.XQ   4.1838     6.3980   0.654   0.5231
IQ.CPA.SOCI.XQ   1.6818     7.2390   0.232   0.8194
IQ.CPA.PADM.XQ  -4.9000     9.1324  -0.537   0.5994
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 3.516 on 15 degrees of freedom
Multiple R-squared:  0.7829,  Adjusted R-squared:  0.696
F-statistic: 9.013 on 6 and 15 DF,  p-value: 0.0002801


Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
     Min       1Q   Median       3Q      Max
-0.65584 -0.10964 -0.03737  0.14209  0.49179

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     0.49936    2.65739   0.188    0.853
time           -0.03651    0.02977  -1.226    0.239
CC.EST         -1.85864    1.05682  -1.759    0.099 .
```

```
PV.EST           1.07630    0.73801   1.458    0.165
IQ.CPA.ENVR.XQ   0.61678    0.57656   1.070    0.302
IQ.CPA.SOCI.XQ  -0.29718    0.65234  -0.456    0.655
IQ.CPA.PADM.XQ   0.44837    0.82297   0.545    0.594
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.3169 on 15 degrees of freedom
Multiple R-squared:  0.5509,  Adjusted R-squared:  0.3712
F-statistic: 3.066 on 6 and 15 DF,  p-value: 0.03658
```

Table 13: Summary of Political Model

```
> summary(pol.m)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
      Min        1Q    Median        3Q       Max
-0.092151 -0.025252 -0.006554  0.030691  0.109987

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     5.21280    0.48996  10.639 2.20e-08 ***
time           -0.08597    0.00549 -15.660 1.06e-10 ***
CC.EST          0.17590    0.19486   0.903   0.3809
PV.EST         -0.23920    0.13607  -1.758   0.0992 .
IQ.CPA.ENVR.XQ  0.13675    0.10630   1.286   0.2178
IQ.CPA.SOCI.XQ -0.32377    0.12028  -2.692   0.0167 *
IQ.CPA.PADM.XQ  0.16877    0.15174   1.112   0.2835
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.05842 on 15 degrees of freedom
Multiple R-squared:  0.9933,  Adjusted R-squared:  0.9906
F-statistic: 368.1 on 6 and 15 DF,  p-value: 2.083e-15


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))
```

```
36
37 Residuals:
38     Min       1Q   Median       3Q      Max
39 -16.246   -7.379   -3.610    7.541   16.934
40
41 Coefficients:
42                Estimate Std. Error t value Pr(>|t|)
43 (Intercept)     727.108     97.373   7.467 1.99e-06 ***
44 time             -6.669      1.091  -6.113 1.98e-05 ***
45 CC.EST           63.367     38.724   1.636   0.1226
46 PV.EST           59.822     27.042   2.212   0.0429 *
47 IQ.CPA.ENVR.XQ   29.933     21.126   1.417   0.1770
48 IQ.CPA.SOCI.XQ  -33.163     23.903  -1.387   0.1856
49 IQ.CPA.PADM.XQ  -46.380     30.155  -1.538   0.1449
50 ---
51 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
               1
52
53 Residual standard error: 11.61 on 15 degrees of freedom
54 Multiple R-squared:  0.9553,  Adjusted R-squared:  0.9375
55 F-statistic: 53.46 on 6 and 15 DF,  p-value: 2.798e-09
56
57
58 Response SH.HIV.1524.FE.ZS :
59
60 Call:
61 lm(formula = SH.HIV.1524.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
62     IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
63     data = cbind(time, pol))
64
65 Residuals:
66     Min       1Q   Median       3Q      Max
67 -0.4605 -0.2662 -0.1489  0.2529  0.6944
68
69 Coefficients:
70                Estimate Std. Error t value Pr(>|t|)
71 (Intercept)     3.92318    3.52296   1.114 0.282976
72 time           -0.17138    0.03947  -4.342 0.000581 ***
73 CC.EST         -2.78811    1.40105  -1.990 0.065138 .
74 PV.EST          2.65573    0.97840   2.714 0.015991 *
75 IQ.CPA.ENVR.XQ  0.48920    0.76436   0.640 0.531821
76 IQ.CPA.SOCI.XQ  0.32858    0.86482   0.380 0.709314
77 IQ.CPA.PADM.XQ -0.19923    1.09102  -0.183 0.857553
78 ---
79 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
               1
80
81 Residual standard error: 0.4201 on 15 degrees of freedom
82 Multiple R-squared:  0.9041,  Adjusted R-squared:  0.8658
83 F-statistic: 23.58 on 6 and 15 DF,  p-value: 7.794e-07
```

```
84
85
86  Response SP.POP.TOTL.FE.ZS :
87
88  Call:
89  lm(formula = SP.POP.TOTL.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
90      IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
91      data = cbind(time, pol))
92
93  Residuals:
94        Min         1Q     Median         3Q        Max
95  -0.051613 -0.031093  0.000221  0.027455  0.069292
96
97  Coefficients:
98                  Estimate Std. Error t value Pr(>|t|)
99  (Intercept)    51.147341   0.341493 149.776   <2e-16 ***
100 time            0.004201   0.003826   1.098   0.2896
101 CC.EST         -0.024467   0.135809  -0.180   0.8594
102 PV.EST          0.268901   0.094840   2.835   0.0125 *
103 IQ.CPA.ENVR.XQ  0.029730   0.074092   0.401   0.6939
104 IQ.CPA.SOCI.XQ -0.123766   0.083830  -1.476   0.1605
105 IQ.CPA.PADM.XQ -0.063532   0.105757  -0.601   0.5570
106 ---
107 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
108
109 Residual standard error: 0.04072 on 15 degrees of freedom
110 Multiple R-squared:  0.515, Adjusted R-squared:  0.321
111 F-statistic: 2.654 on 6 and 15 DF,  p-value: 0.05856
112
113
114 Response SP.DYN.LE00.FE.IN :
115
116 Call:
117 lm(formula = SP.DYN.LE00.FE.IN ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
118     IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
119     data = cbind(time, pol))
120
121 Residuals:
122      Min       1Q   Median       3Q      Max
123 -1.08997 -0.43235  0.08706  0.41667  1.06964
124
125 Coefficients:
126                 Estimate Std. Error t value Pr(>|t|)
127 (Intercept)    36.88945    5.99487   6.154 1.85e-05 ***
128 time            0.48557    0.06717   7.229 2.93e-06 ***
129 CC.EST         -2.83126    2.38411  -1.188   0.2535
130 PV.EST         -4.69575    1.66490  -2.820   0.0129 *
131 IQ.CPA.ENVR.XQ -2.18292    1.30068  -1.678   0.1140
132 IQ.CPA.SOCI.XQ  2.41321    1.47163   1.640   0.1218
```

```
IQ.CPA.PADM.XQ  2.78130    1.85655   1.498   0.1549
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.7148 on 15 degrees of freedom
Multiple R-squared:  0.9682,  Adjusted R-squared:  0.9555
F-statistic: 76.23 on 6 and 15 DF,  p-value: 2.212e-10


Response SL.AGR.EMPL.FE.ZS :

Call:
lm(formula = SL.AGR.EMPL.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
     Min       1Q   Median       3Q      Max
-0.39693 -0.15335  0.00222  0.08143  0.35661

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    55.21359    2.06911  26.685 4.67e-14 ***
time           -0.98589    0.02318 -42.527  < 2e-16 ***
CC.EST         -0.13515    0.82287  -0.164  0.87173
PV.EST          1.50305    0.57463   2.616  0.01948 *
IQ.CPA.ENVR.XQ  1.50415    0.44892   3.351  0.00438 **
IQ.CPA.SOCI.XQ  0.01188    0.50793   0.023  0.98164
IQ.CPA.PADM.XQ -0.88626    0.64078  -1.383  0.18688
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2467 on 15 degrees of freedom
Multiple R-squared:  0.9989,  Adjusted R-squared:  0.9984
F-statistic:  2178 on 6 and 15 DF,  p-value: < 2.2e-16


Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
    Min      1Q  Median      3Q     Max
-0.4058 -0.1934 -0.0052  0.1658  0.5385

```

```
Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)    12.54185    2.48863   5.040 0.000147 ***
time            0.17811    0.02788   6.388 1.22e-05 ***
CC.EST         -0.42683    0.98971  -0.431 0.672411
PV.EST          2.16805    0.69114   3.137 0.006786 **
IQ.CPA.ENVR.XQ  0.05250    0.53995   0.097 0.923824
IQ.CPA.SOCI.XQ -1.02684    0.61091  -1.681 0.113496
IQ.CPA.PADM.XQ -0.08697    0.77070  -0.113 0.911652
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2967 on 15 degrees of freedom
Multiple R-squared:  0.938, Adjusted R-squared:  0.9133
F-statistic: 37.85 on 6 and 15 DF,  p-value: 3.15e-08


Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
    Min      1Q  Median      3Q     Max
-5.3441 -2.2942 -0.1508  2.3300  6.0945

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)     55.1032    29.4888   1.869   0.0813 .
time            -0.9119     0.3304  -2.760   0.0146 *
CC.EST         -12.3942    11.7275  -1.057   0.3073
PV.EST          19.5773     8.1897   2.390   0.0304 *
IQ.CPA.ENVR.XQ   4.1838     6.3980   0.654   0.5231
IQ.CPA.SOCI.XQ   1.6818     7.2390   0.232   0.8194
IQ.CPA.PADM.XQ  -4.9000     9.1324  -0.537   0.5994
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 3.516 on 15 degrees of freedom
Multiple R-squared:  0.7829,  Adjusted R-squared:  0.696
F-statistic: 9.013 on 6 and 15 DF,  p-value: 0.0002801


Response SH.STA.SUIC.FE.P5 :

Call:
```

```
lm(formula = SH.STA.SUIC.FE.P5 ~ (time + CC.EST + PV.EST + IQ.CPA.GNDR.XQ +
    IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ + IQ.CPA.PADM.XQ) - IQ.CPA.GNDR.XQ,
    data = cbind(time, pol))

Residuals:
     Min       1Q   Median       3Q      Max
-0.65584 -0.10964 -0.03737  0.14209  0.49179

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     0.49936    2.65739   0.188    0.853
time           -0.03651    0.02977  -1.226    0.239
CC.EST         -1.85864    1.05682  -1.759    0.099 .
PV.EST          1.07630    0.73801   1.458    0.165
IQ.CPA.ENVR.XQ  0.61678    0.57656   1.070    0.302
IQ.CPA.SOCI.XQ -0.29718    0.65234  -0.456    0.655
IQ.CPA.PADM.XQ  0.44837    0.82297   0.545    0.594
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 0.3169 on 15 degrees of freedom
Multiple R-squared:  0.5509,  Adjusted R-squared:  0.3712
F-statistic: 3.066 on 6 and 15 DF,  p-value: 0.03658
```

Table 14: Summary of Health Model

```
> summary(health.m)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
      Min        1Q    Median        3Q       Max
-0.045426 -0.016462  0.001865  0.011456  0.061598

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)       -2.922e+02  5.260e+01  -5.555 5.51e-05 ***
time              -3.981e+00  6.914e-01  -5.758 3.78e-05 ***
SH.MLR.INCD.P3     2.549e-03  7.144e-04   3.569   0.0028 **
SH.STA.SMSS.RU.ZS  1.165e+01  2.065e+00   5.643 4.68e-05 ***
SH.IMM.HEPB        1.810e-03  1.927e-03   0.939   0.3626
SH.IMM.MEAS        1.139e-03  2.021e-03   0.563   0.5815
```

```
SH.DTH.NMRT         1.001e-04  1.780e-05   5.627 4.82e-05 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.02965 on 15 degrees of freedom
Multiple R-squared:  0.9983,  Adjusted R-squared:  0.9976
F-statistic:  1436 on 6 and 15 DF,  p-value: < 2.2e-16


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
    Min      1Q  Median      3Q     Max
-9.2194 -3.0275 -0.7477  3.3597 10.4389

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)       -3.702e+04  1.024e+04  -3.616  0.00254 **
time              -4.894e+02  1.346e+02  -3.636  0.00244 **
SH.MLR.INCD.P3     8.494e-01  1.391e-01   6.107 2.01e-05 ***
SH.STA.SMSS.RU.ZS  1.461e+03  4.020e+02   3.635  0.00244 **
SH.IMM.HEPB        1.642e-01  3.752e-01   0.438  0.66780
SH.IMM.MEAS       -7.500e-02  3.935e-01  -0.191  0.85140
SH.DTH.NMRT        1.379e-02  3.465e-03   3.979  0.00121 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 5.773 on 15 degrees of freedom
Multiple R-squared:  0.989, Adjusted R-squared:  0.9845
F-statistic: 223.9 on 6 and 15 DF,  p-value: 8.341e-14


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
```

```
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
      Min        1Q    Median        3Q       Max
-0.119764 -0.049254 -0.007466  0.045407  0.162522

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)       -1.771e+02  1.591e+02  -1.113  0.28309
time              -3.049e+00  2.091e+00  -1.458  0.16547
SH.MLR.INCD.P3    -4.233e-03  2.161e-03  -1.959  0.06898 .
SH.STA.SMSS.RU.ZS  7.845e+00  6.246e+00   1.256  0.22832
SH.IMM.HEPB        5.709e-03  5.830e-03   0.979  0.34294
SH.IMM.MEAS        1.937e-02  6.114e-03   3.167  0.00638 **
SH.DTH.NMRT       -4.256e-04  5.383e-05  -7.906 9.96e-07 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.0897 on 15 degrees of freedom
Multiple R-squared:  0.9956,  Adjusted R-squared:  0.9939
F-statistic: 569.5 on 6 and 15 DF,  p-value: < 2.2e-16


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
       Min          1Q      Median          3Q         Max
-0.0149611 -0.0075335 -0.0000954  0.0076680  0.0148110

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)       -3.567e+01  1.910e+01  -1.867 0.081538 .
time              -1.152e+00  2.511e-01  -4.588 0.000355 ***
SH.MLR.INCD.P3     1.069e-03  2.595e-04   4.119 0.000910 ***
SH.STA.SMSS.RU.ZS  3.423e+00  7.499e-01   4.564 0.000373 ***
SH.IMM.HEPB       -5.261e-04  6.999e-04  -0.752 0.463888
SH.IMM.MEAS       -3.601e-04  7.341e-04  -0.491 0.630846
SH.DTH.NMRT       -6.092e-06  6.463e-06  -0.943 0.360851
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1
```

```
120
121 Residual standard error: 0.01077 on 15 degrees of freedom
122 Multiple R-squared:  0.9661,  Adjusted R-squared:  0.9525
123 F-statistic: 71.19 on 6 and 15 DF,  p-value: 3.621e-10
124
125
126 Response SP.DYN.LE00.FE.IN :
127
128 Call:
129 lm(formula = SP.DYN.LE00.FE.IN ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
130     SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
131     SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
132     SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
133     SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
134     SH.IMM.IDPT, data = cbind(time, health))
135
136 Residuals:
137     Min      1Q  Median      3Q     Max
138 -0.5561 -0.2278  0.0289  0.2265  0.4453
139
140 Coefficients:
141                     Estimate Std. Error t value Pr(>|t|)
142 (Intercept)        2.764e+03  5.516e+02   5.011 0.000155 ***
143 time               3.584e+01  7.251e+00   4.942 0.000177 ***
144 SH.MLR.INCD.P3    -4.897e-02  7.492e-03  -6.536 9.42e-06 ***
145 SH.STA.SMSS.RU.ZS -1.063e+02  2.165e+01  -4.907 0.000190 ***
146 SH.IMM.HEPB       -1.084e-02  2.021e-02  -0.536 0.599716
147 SH.IMM.MEAS        5.365e-03  2.120e-02   0.253 0.803634
148 SH.DTH.NMRT       -6.817e-04  1.866e-04  -3.652 0.002359 **
149 ---
150 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
151
152 Residual standard error: 0.311 on 15 degrees of freedom
153 Multiple R-squared:  0.994, Adjusted R-squared:  0.9916
154 F-statistic: 413.5 on 6 and 15 DF,  p-value: 8.771e-16
155
156
157 Response SL.AGR.EMPL.FE.ZS :
158
159 Call:
160 lm(formula = SL.AGR.EMPL.FE.ZS ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
161     SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
162     SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
163     SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
164     SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
165     SH.IMM.IDPT, data = cbind(time, health))
166
167 Residuals:
168      Min       1Q   Median       3Q      Max
```

```
-0.58048 -0.07479  0.06437  0.10652  0.49565

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)        -1.258e+03  4.754e+02  -2.646   0.0183 *
time               -1.823e+01  6.250e+00  -2.917   0.0106 *
SH.MLR.INCD.P3      1.428e-02  6.457e-03   2.212   0.0429 *
SH.STA.SMSS.RU.ZS   5.161e+01  1.866e+01   2.765   0.0144 *
SH.IMM.HEPB         2.593e-02  1.742e-02   1.488   0.1574
SH.IMM.MEAS         2.778e-03  1.827e-02   0.152   0.8812
SH.DTH.NMRT         2.748e-04  1.609e-04   1.708   0.1082
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.268 on 15 degrees of freedom
Multiple R-squared:  0.9986,  Adjusted R-squared:  0.9981
F-statistic:  1845 on 6 and 15 DF,  p-value: < 2.2e-16


Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
      Min        1Q    Median        3Q       Max
-0.236382 -0.099870 -0.003426  0.085754  0.240194

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)        -6.402e+02  2.549e+02  -2.511   0.0240 *
time               -8.664e+00  3.351e+00  -2.585   0.0207 *
SH.MLR.INCD.P3      3.653e-03  3.462e-03   1.055   0.3081
SH.STA.SMSS.RU.ZS   2.595e+01  1.001e+01   2.593   0.0204 *
SH.IMM.HEPB         5.150e-03  9.341e-03   0.551   0.5895
SH.IMM.MEAS        -1.633e-02  9.797e-03  -1.667   0.1163
SH.DTH.NMRT        -1.430e-04  8.626e-05  -1.658   0.1181
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.1437 on 15 degrees of freedom
Multiple R-squared:  0.9855,  Adjusted R-squared:  0.9797
F-statistic: 169.5 on 6 and 15 DF,  p-value: 6.5e-13
```

```
Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
      Min        1Q    Median        3Q       Max
-1.78934 -0.33327 -0.01549  0.38953  1.15404

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)       -2.326e+03  1.438e+03  -1.617  0.12661
time              -3.376e+01  1.890e+01  -1.786  0.09430 .
SH.MLR.INCD.P3     4.212e-02  1.953e-02   2.157  0.04767 *
SH.STA.SMSS.RU.ZS  9.580e+01  5.645e+01   1.697  0.11033
SH.IMM.HEPB        6.537e-02  5.269e-02   1.241  0.23379
SH.IMM.MEAS        1.255e-01  5.526e-02   2.271  0.03831 *
SH.DTH.NMRT       -1.643e-03  4.866e-04  -3.377  0.00415 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 0.8107 on 15 degrees of freedom
Multiple R-squared:  0.9885,  Adjusted R-squared:  0.9838
F-statistic: 214.1 on 6 and 15 DF,  p-value: 1.161e-13


Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ (time + SP.DYN.LE00.IN + SP.DYN.IMRT.IN +
    SH.MMR.RISK + SH.MLR.INCD.P3 + SH.STA.SMSS.RU.ZS + SH.HIV.INCD +
    SH.H2O.BASW.ZS + SH.IMM.HEPB + SH.IMM.MEAS + SH.IMM.IDPT +
    SH.DTH.MORT + SH.DTH.NMRT) - SH.HIV.INCD - SP.DYN.LE00.IN -
    SP.DYN.IMRT.IN - SH.MMR.RISK - SH.H2O.BASW.ZS - SH.DTH.MORT -
    SH.IMM.IDPT, data = cbind(time, health))

Residuals:
      Min        1Q    Median        3Q       Max
-0.35488 -0.11149 -0.02244  0.10641  0.28606

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
```

```
(Intercept)        -5.946e+02  3.621e+02  -1.642   0.1213
time               -8.317e+00  4.760e+00  -1.747   0.1010
SH.MLR.INCD.P3     -3.325e-03  4.918e-03  -0.676   0.5093
SH.STA.SMSS.RU.ZS   2.403e+01  1.422e+01   1.690   0.1116
SH.IMM.HEPB         2.460e-02  1.327e-02   1.854   0.0835 .
SH.IMM.MEAS         5.847e-03  1.392e-02   0.420   0.6803
SH.DTH.NMRT        -2.095e-04  1.225e-04  -1.710   0.1079
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2042 on 15 degrees of freedom
Multiple R-squared:  0.8136,  Adjusted R-squared:  0.739
F-statistic: 10.91 on 6 and 15 DF,  p-value: 9.532e-05
```

Table 15: Summary of Education Model

```
> summary(edu.m)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
      Min        1Q    Median        3Q       Max
-0.079082 -0.027693  0.000484  0.020471  0.095409

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        4.8190053  0.7111337   6.777 6.24e-06 ***
time              -0.0499988  0.0243456  -2.054  0.05787 .
SE.COM.DURS       -0.0525576  0.0143323  -3.667  0.00229 **
NY.ADJ.AEDU.GN.ZS  0.0378749  0.0307011   1.234  0.23631
SE.PRM.ENRR       -0.0005998  0.0021828  -0.275  0.78722
SE.XPD.TERT.ZS    -0.0038782  0.0157862  -0.246  0.80927
SE.XPD.PRIM.ZS     0.0101873  0.0097417   1.046  0.31224
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.0521 on 15 degrees of freedom
Multiple R-squared:  0.9946,  Adjusted R-squared:  0.9925
F-statistic: 463.5 on 6 and 15 DF,  p-value: 3.747e-16


Response SP.DYN.AMRT.FE :

Call:
```

```
lm(formula = SP.DYN.AMRT.FE ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
    Min      1Q  Median      3Q     Max
-20.237  -6.631  -3.500   5.214  27.096

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       393.8629   175.0530   2.250   0.0399 *
time               -3.0057     5.9929  -0.502   0.6233
SE.COM.DURS         2.0814     3.5280   0.590   0.5640
NY.ADJ.AEDU.GN.ZS   9.6624     7.5574   1.279   0.2205
SE.PRM.ENRR        -1.8590     0.5373  -3.460   0.0035 **
SE.XPD.TERT.ZS      2.4376     3.8859   0.627   0.5399
SE.XPD.PRIM.ZS      1.5695     2.3980   0.654   0.5227
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 12.83 on 15 degrees of freedom
Multiple R-squared:  0.9455,  Adjusted R-squared:  0.9237
F-statistic: 43.36 on 6 and 15 DF,  p-value: 1.222e-08


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
     Min       1Q   Median       3Q      Max
-0.29236 -0.09881 -0.02335  0.06966  0.46205

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       11.600872   2.784008   4.167 0.000826 ***
time              -0.338317   0.095310  -3.550 0.002911 **
SE.COM.DURS        0.189232   0.056109   3.373 0.004187 **
NY.ADJ.AEDU.GN.ZS -0.587345   0.120191  -4.887 0.000197 ***
SE.PRM.ENRR       -0.021682   0.008545  -2.537 0.022763 *
SE.XPD.TERT.ZS     0.059690   0.061801   0.966 0.349441
SE.XPD.PRIM.ZS    -0.033538   0.038138  -0.879 0.393056
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

```

```
Residual standard error: 0.204 on 15 degrees of freedom
Multiple R-squared:  0.9774,  Adjusted R-squared:  0.9684
F-statistic: 108.1 on 6 and 15 DF,  p-value: 1.756e-11


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
      Min        1Q    Median        3Q       Max
-0.06171 -0.01290  0.00328  0.01671  0.04297

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       50.600244   0.450090 112.422  < 2e-16 ***
time               0.002436   0.015409   0.158 0.876477
SE.COM.DURS        0.013262   0.009071   1.462 0.164391
NY.ADJ.AEDU.GN.ZS -0.005632   0.019431  -0.290 0.775887
SE.PRM.ENRR       -0.005940   0.001382  -4.300 0.000632 ***
SE.XPD.TERT.ZS     0.008112   0.009991   0.812 0.429561
SE.XPD.PRIM.ZS     0.002611   0.006166   0.424 0.677926
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.03298 on 15 degrees of freedom
Multiple R-squared:  0.6819,  Adjusted R-squared:  0.5547
F-statistic: 5.359 on 6 and 15 DF,  p-value: 0.00389


Response SP.DYN.LE00.FE.IN :

Call:
lm(formula = SP.DYN.LE00.FE.IN ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
    Min      1Q  Median      3Q     Max
-1.8862 -0.2168  0.1306  0.4142  1.0939

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       54.71575   10.88293   5.028  0.00015 ***
time               0.31409    0.37258   0.843  0.41247
SE.COM.DURS       -0.14396    0.21934  -0.656  0.52154
```

```
NY.ADJ.AEDU.GN.ZS -0.44793    0.46984  -0.953  0.35552
SE.PRM.ENRR        0.12406    0.03340   3.714  0.00208 **
SE.XPD.TERT.ZS    -0.15205    0.24159  -0.629  0.53858
SE.XPD.PRIM.ZS    -0.08391    0.14908  -0.563  0.58187
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.7973 on 15 degrees of freedom
Multiple R-squared:  0.9605,  Adjusted R-squared:  0.9447
F-statistic: 60.78 on 6 and 15 DF,  p-value: 1.123e-09


Response SL.AGR.EMPL.FE.ZS :

Call:
lm(formula = SL.AGR.EMPL.FE.ZS ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
     Min       1Q   Median       3Q      Max
-0.64513 -0.11878 -0.02308  0.13522  0.88449

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       57.507366   4.454392  12.910 1.58e-09 ***
time              -0.908138   0.152496  -5.955 2.64e-05 ***
SE.COM.DURS       -0.084980   0.089775  -0.947    0.359
NY.ADJ.AEDU.GN.ZS -0.007652   0.192305  -0.040    0.969
SE.PRM.ENRR       -0.021249   0.013673  -1.554    0.141
SE.XPD.TERT.ZS    -0.001352   0.098881  -0.014    0.989
SE.XPD.PRIM.ZS     0.006341   0.061020   0.104    0.919
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.3264 on 15 degrees of freedom
Multiple R-squared:  0.998, Adjusted R-squared:  0.9972
F-statistic:  1244 on 6 and 15 DF,  p-value: < 2.2e-16


Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
```

```
     Min       1Q   Median       3Q      Max
-0.44133 -0.08982  0.02074  0.12496  0.36018

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        10.795533   3.323395   3.248 0.005402 **
time                0.135511   0.113776   1.191 0.252150
SE.COM.DURS         0.061570   0.066980   0.919 0.372522
NY.ADJ.AEDU.GN.ZS -0.061717   0.143478  -0.430 0.673200
SE.PRM.ENRR        -0.048942   0.010201  -4.798 0.000235 ***
SE.XPD.TERT.ZS      0.056446   0.073775   0.765 0.456077
SE.XPD.PRIM.ZS      0.006393   0.045527   0.140 0.890194
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 0.2435 on 15 degrees of freedom
Multiple R-squared:  0.9583,  Adjusted R-squared:  0.9416
F-statistic: 57.43 on 6 and 15 DF,  p-value: 1.683e-09


Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
    Min      1Q  Median      3Q     Max
-2.8697 -0.5553 -0.1074  0.8965  2.9437

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        87.81685   25.34699   3.465  0.00347 **
time               -1.57313    0.86775  -1.813  0.08991 .
SE.COM.DURS         1.22914    0.51085   2.406  0.02947 *
NY.ADJ.AEDU.GN.ZS -3.72368    1.09428  -3.403  0.00393 **
SE.PRM.ENRR        -0.27237    0.07780  -3.501  0.00322 **
SE.XPD.TERT.ZS      0.37654    0.56267   0.669  0.51354
SE.XPD.PRIM.ZS     -0.06811    0.34722  -0.196  0.84713
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 1.857 on 15 degrees of freedom
Multiple R-squared:  0.9394,  Adjusted R-squared:  0.9152
F-statistic: 38.78 on 6 and 15 DF,  p-value: 2.662e-08
```

```
Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ (time + SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    SE.PRM.ENRR + SE.PRE.ENRR + SE.XPD.TERT.ZS + SE.XPD.PRIM.ZS) -
    SE.PRE.ENRR, data = cbind(time, edu))

Residuals:
     Min       1Q   Median       3Q      Max
-0.38280 -0.11882 -0.01737  0.10203  0.39614

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       10.05303    3.26585   3.078  0.00765 **
time              -0.17267    0.11181  -1.544  0.14334
SE.COM.DURS        0.03270    0.06582   0.497  0.62653
NY.ADJ.AEDU.GN.ZS -0.37163    0.14099  -2.636  0.01871 *
SE.PRM.ENRR       -0.01084    0.01002  -1.081  0.29682
SE.XPD.TERT.ZS    -0.01868    0.07250  -0.258  0.80012
SE.XPD.PRIM.ZS    -0.04258    0.04474  -0.952  0.35630
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2393 on 15 degrees of freedom
Multiple R-squared:  0.7439,  Adjusted R-squared:  0.6414
F-statistic: 7.262 on 6 and 15 DF,  p-value: 0.0008857
```

Table 16: Summary of Technology Model

```
> summary(tech.m)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
    ZS,
    data = cbind(time, tech))

Residuals:
      Min        1Q    Median        3Q       Max
-0.061329 -0.020460 -0.007611  0.015263  0.087957

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        4.940e+00  1.842e-01  26.819 9.97e-15 ***
time              -9.495e-02  5.056e-03 -18.779 2.52e-12 ***
IT.MLT.MAIN        4.866e-07  7.458e-08   6.524 7.01e-06 ***
TM.VAL.OTHR.ZS.WT  3.640e-03  2.883e-03   1.262    0.225
BM.GSR.TRAN.ZS     1.713e-03  3.073e-03   0.557    0.585
```

```
EG.ELC.ACCS.ZS     2.691e-03  1.547e-03   1.739    0.101
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.04054 on 16 degrees of freedom
Multiple R-squared:  0.9965,  Adjusted R-squared:  0.9955
F-statistic: 920.3 on 5 and 16 DF,  p-value: < 2.2e-16


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
       ZS,
    data = cbind(time, tech))

Residuals:
     Min       1Q   Median       3Q      Max
-19.0633  -4.1441   0.0476   4.3727  24.5774

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)         5.195e+02  4.475e+01  11.609 3.32e-09 ***
time               -9.367e+00  1.228e+00  -7.627 1.02e-06 ***
IT.MLT.MAIN        -2.424e-05  1.812e-05  -1.338  0.19969
TM.VAL.OTHR.ZS.WT  -9.680e-01  7.004e-01  -1.382  0.18595
BM.GSR.TRAN.ZS     -1.733e+00  7.466e-01  -2.321  0.03384 *
EG.ELC.ACCS.ZS      1.110e+00  3.758e-01   2.953  0.00936 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 9.849 on 16 degrees of freedom
Multiple R-squared:  0.9657,  Adjusted R-squared:  0.955
F-statistic: 90.13 on 5 and 16 DF,  p-value: 3.856e-11


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
       ZS,
    data = cbind(time, tech))

Residuals:
      Min       1Q   Median       3Q      Max
-0.76550 -0.13008  0.07574  0.12885  0.91849
```

```
66
67 Coefficients:
68                       Estimate Std. Error t value Pr(>|t|)
69 (Intercept)         5.207e+00  1.888e+00   2.757 0.014024 *
70 time                -2.343e-01  5.183e-02  -4.520 0.000349 ***
71 IT.MLT.MAIN         -1.706e-06  7.646e-07  -2.232 0.040299 *
72 TM.VAL.OTHR.ZS.WT   5.768e-03  2.956e-02   0.195 0.847737
73 BM.GSR.TRAN.ZS      1.885e-02  3.151e-02   0.598 0.558076
74 EG.ELC.ACCS.ZS      1.385e-02  1.586e-02   0.873 0.395416
75 ---
76 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
              1
77
78 Residual standard error: 0.4156 on 16 degrees of freedom
79 Multiple R-squared:  0.8999,  Adjusted R-squared:  0.8686
80 F-statistic: 28.77 on 5 and 16 DF,  p-value: 1.853e-07
81
82
83 Response SP.POP.TOTL.FE.ZS :
84
85 Call:
86 lm(formula = SP.POP.TOTL.FE.ZS ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
87     BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
           ZS,
88     data = cbind(time, tech))
89
90 Residuals:
91       Min         1Q     Median         3Q        Max
92 -0.040498 -0.018048  0.004809  0.014699  0.052786
93
94 Coefficients:
95                       Estimate Std. Error t value Pr(>|t|)
96 (Intercept)         5.046e+01  1.202e-01 419.985  < 2e-16 ***
97 time                -1.217e-02  3.298e-03  -3.690  0.00198 **
98 IT.MLT.MAIN         -1.148e-07  4.865e-08  -2.360  0.03133 *
99 TM.VAL.OTHR.ZS.WT   2.537e-05  1.881e-03   0.013  0.98940
100 BM.GSR.TRAN.ZS     -2.135e-03  2.005e-03  -1.065  0.30274
101 EG.ELC.ACCS.ZS      3.752e-03  1.009e-03   3.718  0.00187 **
102 ---
103 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
              1
104
105 Residual standard error: 0.02644 on 16 degrees of freedom
106 Multiple R-squared:  0.7818,  Adjusted R-squared:  0.7136
107 F-statistic: 11.47 on 5 and 16 DF,  p-value: 7.863e-05
108
109
110 Response SP.DYN.LE00.FE.IN :
111
112 Call:
```

```
lm(formula = SP.DYN.LE00.FE.IN ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
    ZS,
    data = cbind(time, tech))

Residuals:
     Min       1Q   Median       3Q      Max
-1.65333 -0.20387 -0.06647  0.29971  0.92573

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.090e+01  2.722e+00  18.699 2.69e-12 ***
time               7.133e-01  7.471e-02   9.549 5.20e-08 ***
IT.MLT.MAIN        1.649e-06  1.102e-06   1.496  0.15408
TM.VAL.OTHR.ZS.WT  4.365e-02  4.260e-02   1.025  0.32083
BM.GSR.TRAN.ZS     8.440e-02  4.541e-02   1.859  0.08158 .
EG.ELC.ACCS.ZS    -8.072e-02  2.286e-02  -3.532  0.00277 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 0.599 on 16 degrees of freedom
Multiple R-squared:  0.9762,  Adjusted R-squared:  0.9688
F-statistic: 131.3 on 5 and 16 DF,  p-value: 2.098e-12


Response SL.AGR.EMPL.FE.ZS :

Call:
lm(formula = SL.AGR.EMPL.FE.ZS ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
    ZS,
    data = cbind(time, tech))

Residuals:
     Min       1Q   Median       3Q      Max
-0.59595 -0.14049 -0.00204  0.08428  0.87416

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.512e+01  1.485e+00  37.117  < 2e-16 ***
time              -9.789e-01  4.076e-02 -24.016  5.6e-14 ***
IT.MLT.MAIN        2.305e-07  6.012e-07   0.383    0.707
TM.VAL.OTHR.ZS.WT -8.884e-03  2.324e-02  -0.382    0.707
BM.GSR.TRAN.ZS     9.417e-04  2.478e-02   0.038    0.970
EG.ELC.ACCS.ZS     1.650e-02  1.247e-02   1.323    0.204
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

```

```
Residual standard error: 0.3268 on 16 degrees of freedom
Multiple R-squared:  0.9979,  Adjusted R-squared:  0.9972
F-statistic:  1488 on 5 and 16 DF,  p-value: < 2.2e-16


Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
        ZS,
    data = cbind(time, tech))

Residuals:
      Min        1Q    Median        3Q       Max
-0.34833 -0.13779 -0.00327  0.16989  0.45316

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        7.109e+00  1.039e+00   6.841 3.97e-06 ***
time               3.267e-02  2.852e-02   1.145  0.26897
IT.MLT.MAIN       -6.533e-07  4.208e-07  -1.553  0.14004
TM.VAL.OTHR.ZS.WT  8.446e-03  1.627e-02   0.519  0.61073
BM.GSR.TRAN.ZS    -2.752e-03  1.734e-02  -0.159  0.87586
EG.ELC.ACCS.ZS     3.262e-02  8.727e-03   3.738  0.00179 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 0.2287 on 16 degrees of freedom
Multiple R-squared:  0.9607,  Adjusted R-squared:  0.9485
F-statistic: 78.29 on 5 and 16 DF,  p-value: 1.133e-10


Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
        ZS,
    data = cbind(time, tech))

Residuals:
    Min      1Q  Median      3Q     Max
-6.3437 -0.6275  0.1404  1.2312  5.8878

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.906e+01  1.366e+01   4.325 0.000523 ***
time              -1.277e+00  3.748e-01  -3.406 0.003611 **
```

```
IT.MLT.MAIN        -1.183e-05  5.529e-06  -2.140 0.048104 *
TM.VAL.OTHR.ZS.WT  -1.074e-01  2.137e-01  -0.503 0.622124
BM.GSR.TRAN.ZS     -1.555e-01  2.278e-01  -0.683 0.504586
EG.ELC.ACCS.ZS      1.277e-01  1.147e-01   1.113 0.281946
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 3.005 on 16 degrees of freedom
Multiple R-squared:  0.8308,  Adjusted R-squared:  0.7779
F-statistic: 15.71 on 5 and 16 DF,  p-value: 1.113e-05


Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ (time + IT.MLT.MAIN + TM.VAL.OTHR.ZS.WT +
    BM.GSR.TRAN.ZS + EG.ELC.ACCS.RU.ZS + EG.ELC.ACCS.ZS) - EG.ELC.ACCS.RU.
        ZS,
    data = cbind(time, tech))

Residuals:
     Min       1Q   Median       3Q      Max
-0.67553 -0.11944  0.00416  0.12068  0.67070

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)         2.614e+00  1.535e+00   1.703    0.108
time               -7.231e-02  4.213e-02  -1.717    0.105
IT.MLT.MAIN         9.732e-08  6.214e-07   0.157    0.878
TM.VAL.OTHR.ZS.WT   3.814e-03  2.402e-02   0.159    0.876
BM.GSR.TRAN.ZS      1.935e-02  2.561e-02   0.755    0.461
EG.ELC.ACCS.ZS      1.205e-02  1.289e-02   0.935    0.364

Residual standard error: 0.3378 on 16 degrees of freedom
Multiple R-squared:  0.4555,  Adjusted R-squared:  0.2854
F-statistic: 2.677 on 5 and 16 DF,  p-value: 0.06077
```

13.2 Residual Analysis Prior to the Genetic Algorithm

1. **Residuals are Uncorrelated:**
Based on the Residuals versus Observation Order plot in **Figure 23**, none of the models appear to have highly correlated residuals, since the data points do not appear to follow an obvious trend. Although the plot seems to indicate inconsistent variances in the residuals, since most of the observations have residuals that are close to zero, while the rest are more scattered.

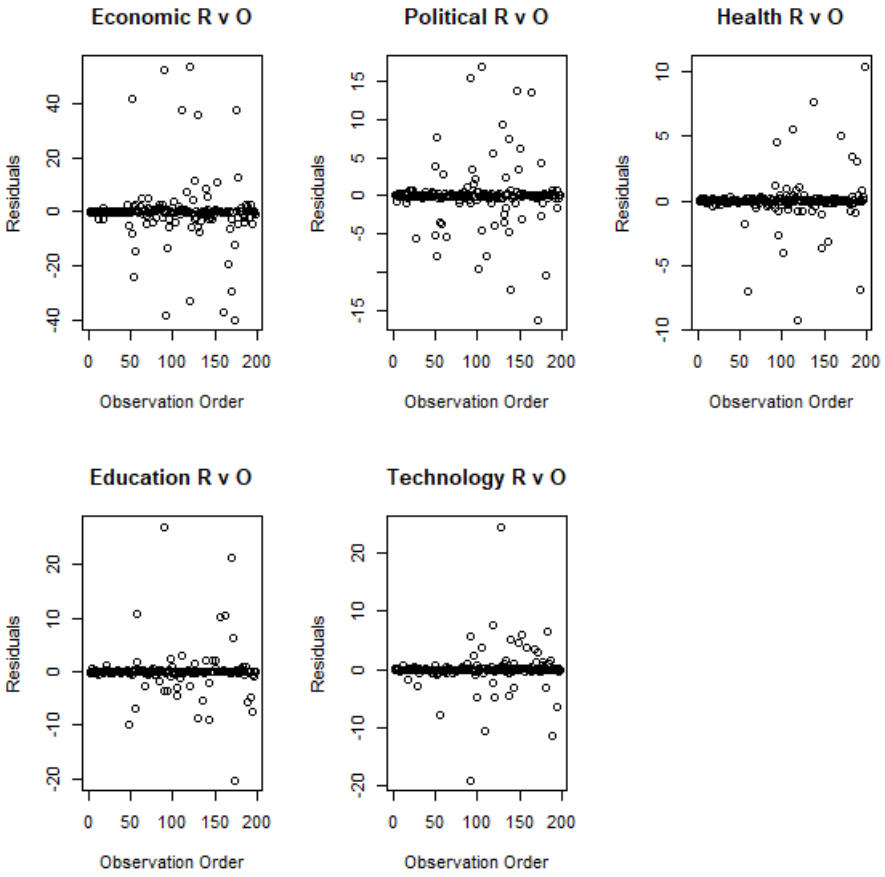

Figure 34: Residual versus Order Plots

2. **Residuals Maintain Constant Variance:**
The plots of the Residuals versus Fitted Values in **Figure 24** demonstrate unequal variance in the residuals of the 5 models. The variance of the residuals drastically increases with larger fitted values.

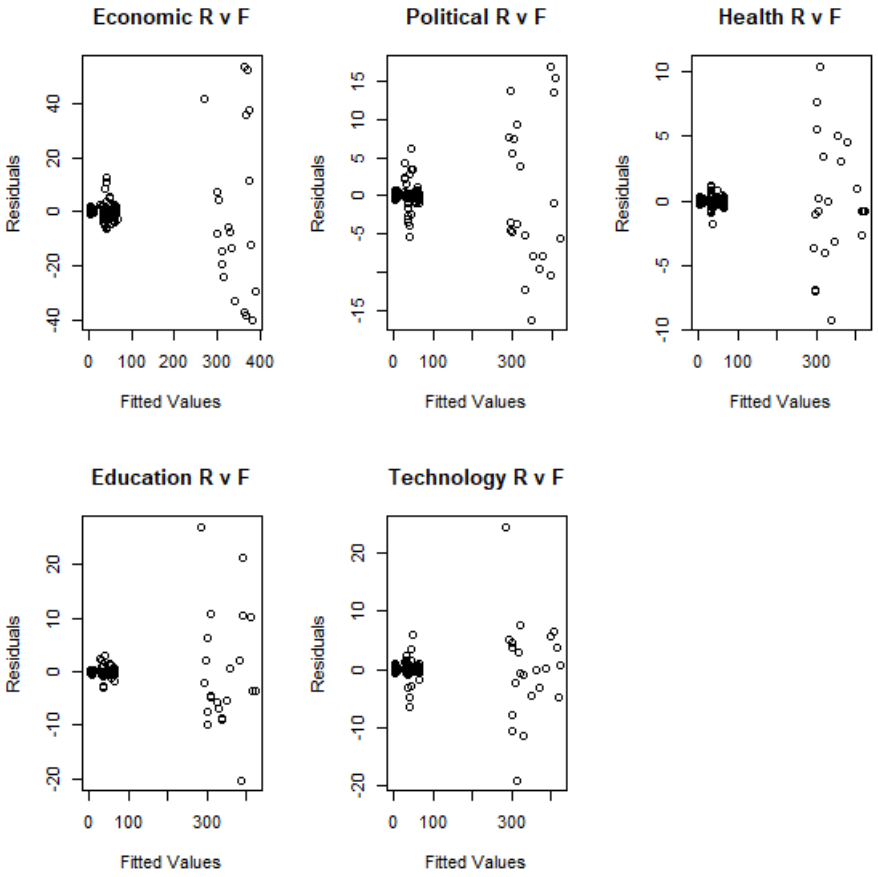

Figure 35: Residual versus Fitted Plots

3. **Normally Distributed Residuals:**

- **Univariate Normality:**

  The residuals for the 5 models do not appear to follow a univariate normal distribution as shown in the Normal Probability Plots in **Figure 25**.

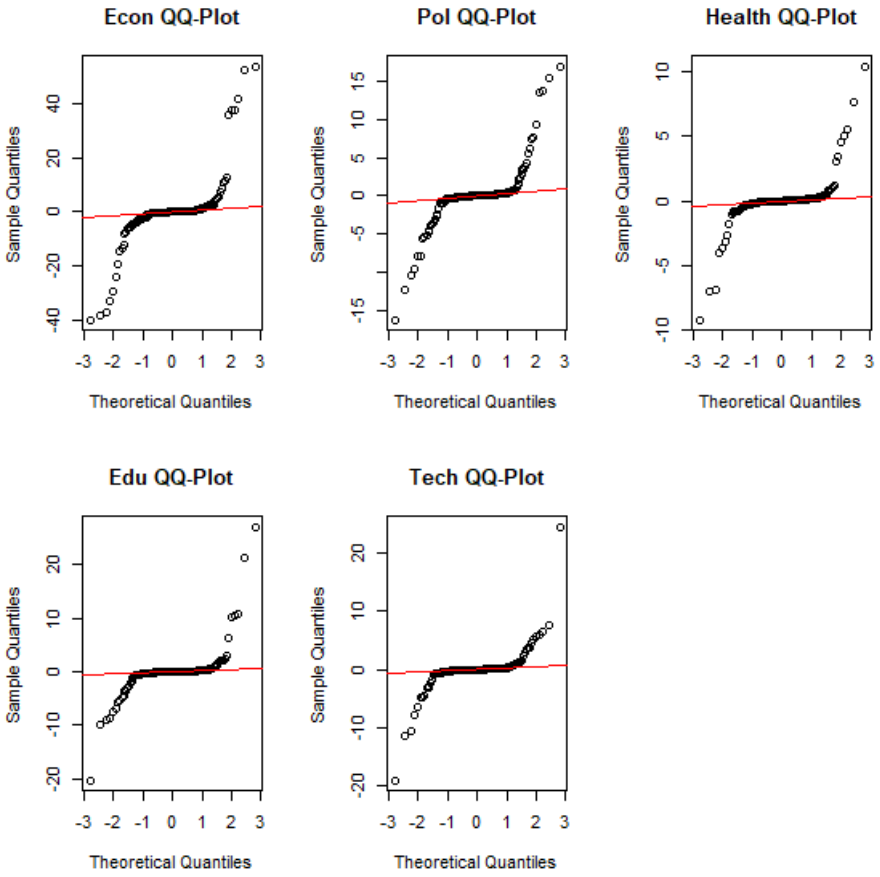

Figure 36: Normal Q-Q Plot of Residuals

- **Multivariate Normality:**

  The multivariate normal probability plots in **Figure 26** exhibit a few observations in each model that could be worsening the residuals correspondence to the normality condition. The observations that are annotated in the plots are those with the largest Mahalanobis distances and could potentially be removed further in the analysis.

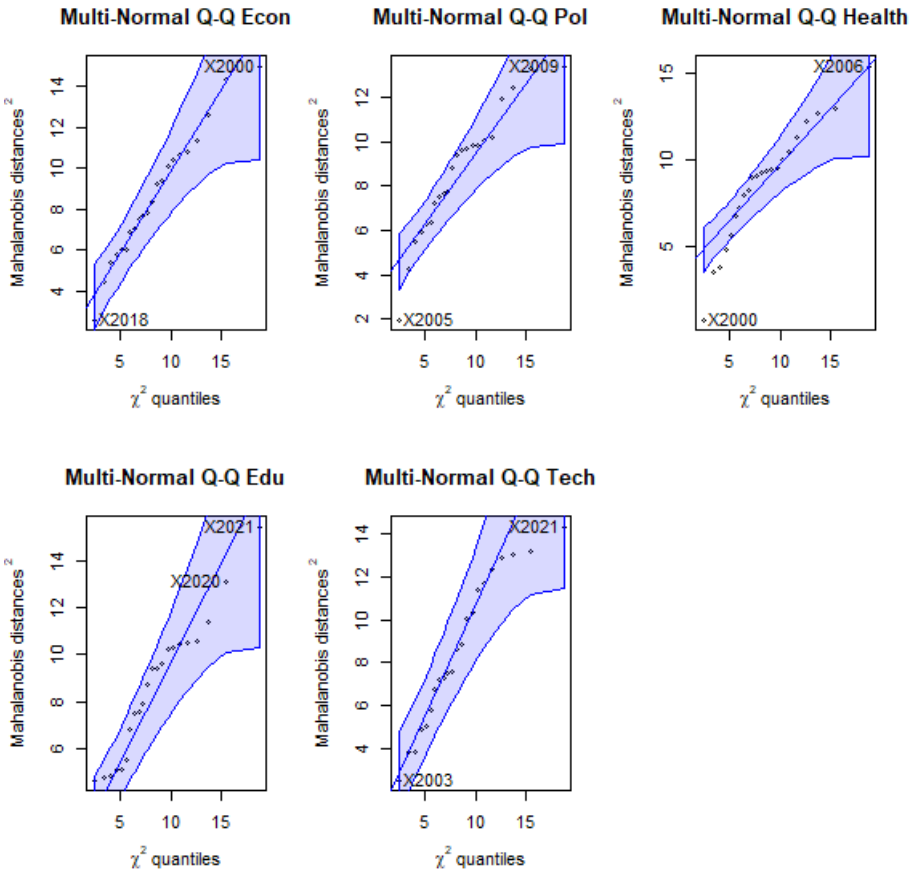

Figure 37: Multivariate Normal Q-Q Plot of Residuals

13.3 Genetic Algorithm Fitness Evolution

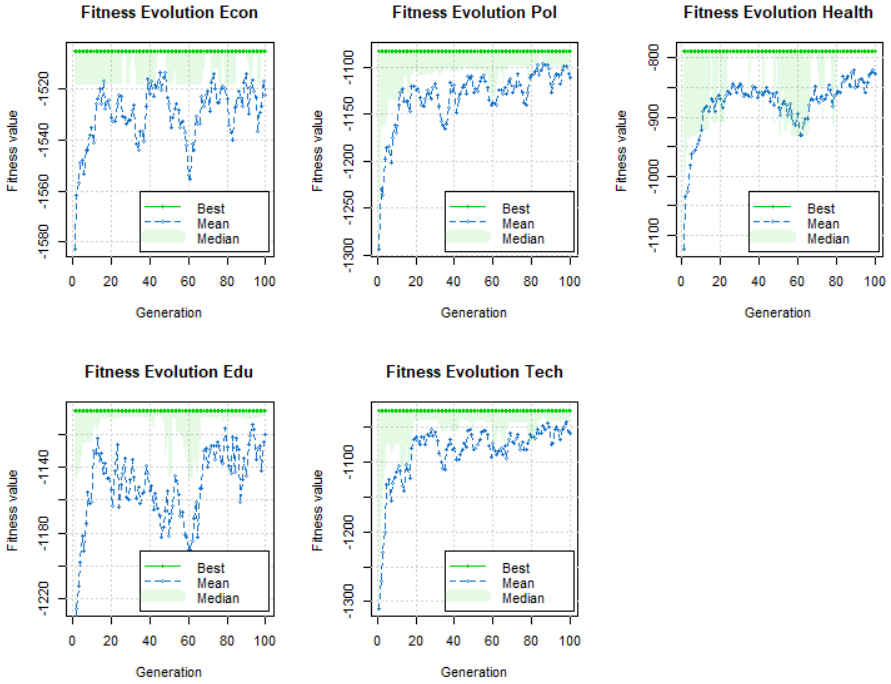

Figure 38: Plots of Genetic Algorithm Fitness Evolution

13.4 Genetic Algorithm Summary

Genetic Algorithm Summaries

```
> summary(GA.econ)
        Genetic Algorithm

GA settings: Type = binary, Population size = 50, Number of generations =
    100,
Elitism = 2, Crossover probability = 0.8, Mutation probability = 0.1
GA results: Iterations = 100, Fitness function value = -1504.881
Solution = BM.KLT.DINV.WD.GD.ZS PA.NUS.FCRF
[1,] 1 1

> summary(GA.pol)
        Genetic Algorithm

GA settings: Type = binary, Population size = 50, Number of generations =
    100,
Elitism = 2, Crossover probability = 0.8, Mutation probability = 0.1
GA results: Iterations = 100, Fitness function value = -1082.931
Solution = time CC.EST PV.EST IQ.CPA.ENVR.XQ IQ.CPA.SOCI.XQ IQ.CPA.PADM.XQ
[1,] 1 1 1 1 1 1

> summary(GA.health)
        Genetic Algorithm

GA settings: Type = binary, Population size = 50, Number of generations =
    100,
Elitism = 2, Crossover probability = 0.8, Mutation probability = 0.1
GA results: Iterations = 100, Fitness function value = -787.9473
Solution = time SH.MLR.INCD.P3 SH.STA.SMSS.RU.ZS SH.IMM.HEPB SH.IMM.MEAS SH
    .DTH.NMRT
[1,] 1 1 1 0 0 1

> summary(GA.edu)
        Genetic Algorithm

GA settings: Type = binary, Population size = 50, Number of generations =
    100,
Elitism = 2, Crossover probability = 0.8, Mutation probability = 0.1
GA results: Iterations = 100, Fitness function value = -1105.115
Solution = time SE.COM.DURS NY.ADJ.AEDU.GN.ZS SE.PRM.ENRR SE.XPD.TERT.ZS SE
    .XPD.PRIM.ZS
[1,] 1 1 1 1 0 0

> summary(GA.tech)
        Genetic Algorithm

GA settings: Type = binary, Population size = 50, Number of generations =
    100,
Elitism = 2, Crossover probability = 0.8, Mutation probability = 0.1
GA results: Iterations = 100, Fitness function value = -1025.73
Solution = time IT.MLT.MAIN TM.VAL.OTHR.ZS.WT BM.GSR.TRAN.ZS EG.ELC.ACCS.ZS
[1,] 1 1 1 1 1
```

13.5 Results of Multiple Regression after Application of Genetic Algorithm

Table 17: Summary of Economic Model

```
> summary(econ.ga)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.35874 -0.20609 -0.00552  0.15971  0.44164

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           7.822005   0.373036  20.969 1.35e-14 ***
BM.KLT.DINV.WD.GD.ZS -0.624750   0.403071  -1.550    0.138
PA.NUS.FCRF          -0.040383   0.004341  -9.303 1.66e-08 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 0.2552 on 19 degrees of freedom
Multiple R-squared:  0.8369,  Adjusted R-squared:  0.8198
F-statistic: 48.76 on 2 and 19 DF,  p-value: 3.29e-08


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
    Min      1Q  Median      3Q     Max
-40.029 -23.167  -7.878  29.983  54.041

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           560.001     47.353  11.826 3.31e-10 ***
BM.KLT.DINV.WD.GD.ZS  -70.504     51.166  -1.378 0.184234
PA.NUS.FCRF            -2.414      0.551  -4.382 0.000321 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1

Residual standard error: 32.4 on 19 degrees of freedom
```

```
Multiple R-squared:  0.5594,  Adjusted R-squared:  0.513
F-statistic: 12.06 on 2 and 19 DF,  p-value: 0.0004153


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-1.02839 -0.58845 -0.03671  0.21830  2.29794

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           8.57397    1.26427   6.782 1.78e-06 ***
BM.KLT.DINV.WD.GD.ZS -1.51241    1.36607  -1.107  0.28206
PA.NUS.FCRF          -0.05608    0.01471  -3.812  0.00118 **
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.865 on 19 degrees of freedom
Multiple R-squared:  0.4852,  Adjusted R-squared:  0.431
F-statistic: 8.954 on 2 and 19 DF,  p-value: 0.001822


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
      Min        1Q    Median        3Q       Max
-0.069352 -0.019672 -0.006209  0.009123  0.086599

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)          50.1927125  0.0601896 833.910   <2e-16 ***
BM.KLT.DINV.WD.GD.ZS -0.1492739  0.0650358  -2.295   0.0333 *
PA.NUS.FCRF           0.0019775  0.0007004   2.823   0.0109 *
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.04118 on 19 degrees of freedom
Multiple R-squared:  0.3717,  Adjusted R-squared:  0.3056
F-statistic:  5.62 on 2 and 19 DF,  p-value: 0.01209
```

```
92
93
94  Response SP.DYN.LE00.FE.IN :
95
96  Call:
97  lm(formula = SP.DYN.LE00.FE.IN ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
98      data = econ.new[, GA.econ@solution == 1])
99
100 Residuals:
101     Min      1Q  Median      3Q     Max
102 -3.8350 -1.8546  0.5683  1.5539  2.8586
103
104 Coefficients:
105                     Estimate Std. Error t value Pr(>|t|)
106 (Intercept)          45.21451    3.35808  13.464 3.62e-11 ***
107 BM.KLT.DINV.WD.GD.ZS  5.07361    3.62846   1.398  0.17814
108 PA.NUS.FCRF           0.18118    0.03908   4.637  0.00018 ***
109 ---
110 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
111
112 Residual standard error: 2.297 on 19 degrees of freedom
113 Multiple R-squared:  0.5845,  Adjusted R-squared:  0.5408
114 F-statistic: 13.37 on 2 and 19 DF,  p-value: 0.0002377
115
116
117 Response SL.AGR.EMPL.FE.ZS :
118
119 Call:
120 lm(formula = SL.AGR.EMPL.FE.ZS ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
121     data = econ.new[, GA.econ@solution == 1])
122
123 Residuals:
124     Min      1Q  Median      3Q     Max
125 -4.5272 -2.2365  0.1002  1.8083  5.4704
126
127 Coefficients:
128                     Estimate Std. Error t value Pr(>|t|)
129 (Intercept)          79.19967    4.57281  17.320 4.28e-13 ***
130 BM.KLT.DINV.WD.GD.ZS -5.98183    4.94100  -1.211    0.241
131 PA.NUS.FCRF          -0.39641    0.05321  -7.450 4.75e-07 ***
132 ---
133 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
134
135 Residual standard error: 3.129 on 19 degrees of freedom
136 Multiple R-squared:  0.7665,  Adjusted R-squared:  0.7419
137 F-statistic: 31.19 on 2 and 19 DF,  p-value: 9.967e-07
138
139
```

```
Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.51002 -0.31930  0.01119  0.24204  0.68778

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           2.441394   0.543691   4.490 0.000251 ***
BM.KLT.DINV.WD.GD.ZS -0.462563   0.587467  -0.787 0.440769
PA.NUS.FCRF           0.073026   0.006327  11.543 4.98e-10 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.372 on 19 degrees of freedom
Multiple R-squared:  0.8767,  Adjusted R-squared:  0.8637
F-statistic: 67.53 on 2 and 19 DF,  p-value: 2.317e-09


Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
    Min      1Q  Median      3Q     Max
-6.3033 -3.4557 -0.5933  1.9823 12.8351

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           56.63767    8.05629   7.030 1.08e-06 ***
BM.KLT.DINV.WD.GD.ZS -12.36353    8.70495  -1.420   0.1717
PA.NUS.FCRF           -0.22106    0.09375  -2.358   0.0292 *
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 5.512 on 19 degrees of freedom
Multiple R-squared:  0.3242,  Adjusted R-squared:  0.253
F-statistic: 4.557 on 2 and 19 DF,  p-value: 0.02418


Response SH.STA.SUIC.FE.P5 :

```

```
Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ BM.KLT.DINV.WD.GD.ZS + PA.NUS.FCRF,
    data = econ.new[, GA.econ@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.64617 -0.13247 -0.02159  0.08728  0.99249

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           4.532723   0.506483   8.949 3.05e-08 ***
BM.KLT.DINV.WD.GD.ZS -0.623361   0.547263  -1.139   0.2688
PA.NUS.FCRF          -0.014771   0.005894  -2.506   0.0215 *
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.3465 on 19 degrees of freedom
Multiple R-squared:  0.3196,  Adjusted R-squared:  0.248
F-statistic: 4.463 on 2 and 19 DF,  p-value: 0.02576
```

Table 18: Summary of Political Model

```
> summary(pol.ga)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
    time, data = pol.new[, GA.pol@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.09276 -0.04306 -0.01056  0.03694  0.10359

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)     5.529257   0.395599  13.977 4.18e-11 ***
IQ.CPA.ENVR.XQ  0.229210   0.098797   2.320   0.0323 *
IQ.CPA.SOCI.XQ -0.299977   0.116831  -2.568   0.0194 *
time           -0.087106   0.004919 -17.707 7.79e-13 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.06061 on 18 degrees of freedom
Multiple R-squared:  0.9913,  Adjusted R-squared:  0.9898
F-statistic: 682.8 on 3 and 18 DF,  p-value: < 2.2e-16


Response SP.DYN.AMRT.FE :
```

```
27
28 Call:
29 lm(formula = SP.DYN.AMRT.FE ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
30     time, data = pol.new[, GA.pol@solution == 1])
31
32 Residuals:
33     Min      1Q  Median      3Q     Max
34 -27.784  -7.779  -3.325   9.828  31.610
35
36 Coefficients:
37               Estimate Std. Error t value Pr(>|t|)
38 (Intercept)     579.264    101.228   5.722    2e-05 ***
39 IQ.CPA.ENVR.XQ    6.765     25.281   0.268  0.79205
40 IQ.CPA.SOCI.XQ  -58.948     29.895  -1.972  0.06420 .
41 time             -4.685      1.259  -3.722  0.00156 **
42 ---
43 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1
44
45 Residual standard error: 15.51 on 18 degrees of freedom
46 Multiple R-squared:  0.9044,  Adjusted R-squared:  0.8884
47 F-statistic: 56.73 on 3 and 18 DF,  p-value: 2.256e-09
48
49
50 Response SH.HIV.1524.FE.ZS :
51
52 Call:
53 lm(formula = SH.HIV.1524.FE.ZS ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
54     time, data = pol.new[, GA.pol@solution == 1])
55
56 Residuals:
57      Min       1Q   Median       3Q      Max
58 -0.56847 -0.35533  0.02056  0.17499  1.33162
59
60 Coefficients:
61               Estimate Std. Error t value Pr(>|t|)
62 (Intercept)     4.15741    3.10233   1.340 0.196887
63 IQ.CPA.ENVR.XQ -0.12892    0.77478  -0.166 0.869703
64 IQ.CPA.SOCI.XQ  0.54905    0.91620   0.599 0.556460
65 time           -0.17988    0.03858  -4.663 0.000194 ***
66 ---
67 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1
68
69 Residual standard error: 0.4753 on 18 degrees of freedom
70 Multiple R-squared:  0.8528,  Adjusted R-squared:  0.8282
71 F-statistic: 34.75 on 3 and 18 DF,  p-value: 1.068e-07
72
73
74 Response SP.POP.TOTL.FE.ZS :
```

```
75
76 Call:
77 lm(formula = SP.POP.TOTL.FE.ZS ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
78     time, data = pol.new[, GA.pol@solution == 1])
79
80 Residuals:
81       Min         1Q     Median         3Q        Max
82 -0.075848 -0.025362 -0.002805  0.027611  0.089361
83
84 Coefficients:
85                 Estimate Std. Error t value Pr(>|t|)
86 (Intercept)    50.940823   0.314871 161.783   <2e-16 ***
87 IQ.CPA.ENVR.XQ -0.041247   0.078636  -0.525   0.6063
88 IQ.CPA.SOCI.XQ -0.155783   0.092990  -1.675   0.1112
89 time            0.007585   0.003915   1.937   0.0686 .
90 ---
91 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
               1
92
93 Residual standard error: 0.04824 on 18 degrees of freedom
94 Multiple R-squared:  0.1832,  Adjusted R-squared:  0.0471
95 F-statistic: 1.346 on 3 and 18 DF,  p-value: 0.2909
96
97
98 Response SP.DYN.LE00.FE.IN :
99
100 Call:
101 lm(formula = SP.DYN.LE00.FE.IN ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
102     time, data = pol.new[, GA.pol@solution == 1])
103
104 Residuals:
105     Min      1Q  Median      3Q     Max
106 -2.1296 -0.6627  0.1948  0.4167  1.8342
107
108 Coefficients:
109                Estimate Std. Error t value Pr(>|t|)
110 (Intercept)    45.60469    6.40779   7.117 1.24e-06 ***
111 IQ.CPA.ENVR.XQ -0.55812    1.60028  -0.349 0.731315
112 IQ.CPA.SOCI.XQ  3.88518    1.89239   2.053 0.054894 .
113 time            0.36744    0.07968   4.611 0.000217 ***
114 ---
115 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
               1
116
117 Residual standard error: 0.9817 on 18 degrees of freedom
118 Multiple R-squared:  0.9281,  Adjusted R-squared:  0.9162
119 F-statistic:  77.5 on 3 and 18 DF,  p-value: 1.741e-10
120
121
122 Response SL.AGR.EMPL.FE.ZS :
```

```
123
124 Call:
125 lm(formula = SL.AGR.EMPL.FE.ZS ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
126     time, data = pol.new[, GA.pol@solution == 1])
127
128 Residuals:
129      Min       1Q   Median       3Q      Max
130 -0.47408 -0.16704  0.01138  0.09769  0.72069
131
132 Coefficients:
133                Estimate Std. Error t value Pr(>|t|)
134 (Intercept)    53.01901    1.91671  27.662 3.35e-16 ***
135 IQ.CPA.ENVR.XQ  0.97543    0.47868   2.038   0.0565 .
136 IQ.CPA.SOCI.XQ -0.27423    0.56605  -0.484   0.6339
137 time           -0.96440    0.02383 -40.464  < 2e-16 ***
138 ---
139 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
140
141 Residual standard error: 0.2936 on 18 degrees of freedom
142 Multiple R-squared:  0.9981,  Adjusted R-squared:  0.9977
143 F-statistic:  3073 on 3 and 18 DF,  p-value: < 2.2e-16
144
145
146 Response SL.IND.EMPL.FE.ZS :
147
148 Call:
149 lm(formula = SL.IND.EMPL.FE.ZS ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
150     time, data = pol.new[, GA.pol@solution == 1])
151
152 Residuals:
153      Min       1Q   Median       3Q      Max
154 -0.53313 -0.18902 -0.07118  0.25144  0.77946
155
156 Coefficients:
157                Estimate Std. Error t value Pr(>|t|)
158 (Intercept)    11.83837    2.34169   5.055 8.23e-05 ***
159 IQ.CPA.ENVR.XQ -0.41619    0.58481  -0.712    0.486
160 IQ.CPA.SOCI.XQ -1.15880    0.69156  -1.676    0.111
161 time            0.19977    0.02912   6.860 2.03e-06 ***
162 ---
163 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
164
165 Residual standard error: 0.3587 on 18 degrees of freedom
166 Multiple R-squared:  0.8913,  Adjusted R-squared:  0.8732
167 F-statistic: 49.21 on 3 and 18 DF,  p-value: 7.074e-09
168
169
170 Response SL.FAM.WORK.FE.ZS :
```

```
171
172 Call:
173 lm(formula = SL.FAM.WORK.FE.ZS ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
174     time, data = pol.new[, GA.pol@solution == 1])
175
176 Residuals:
177     Min      1Q  Median      3Q     Max
178 -6.3163 -2.7093  0.0261  1.7200  7.9048
179
180 Coefficients:
181                Estimate Std. Error t value Pr(>|t|)
182 (Intercept)     45.5148    24.8164   1.834   0.0832 .
183 IQ.CPA.ENVR.XQ  -1.1500     6.1977  -0.186   0.8549
184 IQ.CPA.SOCI.XQ   1.1731     7.3289   0.160   0.8746
185 time            -0.8304     0.3086  -2.691   0.0149 *
186 ---
187 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
188
189 Residual standard error: 3.802 on 18 degrees of freedom
190 Multiple R-squared:  0.6954,  Adjusted R-squared:  0.6446
191 F-statistic:  13.7 on 3 and 18 DF,  p-value: 6.779e-05
192
193
194 Response SH.STA.SUIC.FE.P5 :
195
196 Call:
197 lm(formula = SH.STA.SUIC.FE.P5 ~ IQ.CPA.ENVR.XQ + IQ.CPA.SOCI.XQ +
198     time, data = pol.new[, GA.pol@solution == 1])
199
200 Residuals:
201      Min       1Q   Median       3Q      Max
202 -0.73962 -0.14661 -0.01630  0.09172  0.80429
203
204 Coefficients:
205                Estimate Std. Error t value Pr(>|t|)
206 (Intercept)     2.04054    2.12227   0.961    0.349
207 IQ.CPA.ENVR.XQ  0.49103    0.53002   0.926    0.366
208 IQ.CPA.SOCI.XQ  0.02754    0.62676   0.044    0.965
209 time           -0.05390    0.02639  -2.043    0.056 .
210 ---
211 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
212
213 Residual standard error: 0.3251 on 18 degrees of freedom
214 Multiple R-squared:  0.4326,  Adjusted R-squared:  0.338
215 F-statistic: 4.574 on 3 and 18 DF,  p-value: 0.01501
```

Table 19: Summary of Health Model

```
> summary(health.ga)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ SH.IMM.MEAS + SH.DTH.NMRT + time,
    data = health.new[, GA.health@solution == 1])

Residuals:
      Min        1Q    Median        3Q       Max
-0.06976  -0.03857   0.00253   0.03203   0.09029

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.075e+00  3.143e-01  12.966 1.44e-10 ***
SH.IMM.MEAS -3.058e-03  1.987e-03  -1.539 0.141282
SH.DTH.NMRT  3.975e-05  8.069e-06   4.926 0.000109 ***
time        -7.311e-02  4.303e-03 -16.988 1.58e-12 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.04831 on 18 degrees of freedom
Multiple R-squared:  0.9945,  Adjusted R-squared:  0.9935
F-statistic:  1078 on 3 and 18 DF,  p-value: < 2.2e-16


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ SH.IMM.MEAS + SH.DTH.NMRT + time,
    data = health.new[, GA.health@solution == 1])

Residuals:
    Min      1Q  Median      3Q     Max
-16.202  -6.026   1.419   6.558  20.466

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) 780.899149  65.566905  11.910 5.70e-10 ***
SH.IMM.MEAS  -1.513756   0.414622  -3.651 0.001828 **
SH.DTH.NMRT  -0.006691   0.001683  -3.974 0.000889 ***
time         -7.947687   0.897799  -8.852 5.63e-08 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 10.08 on 18 degrees of freedom
Multiple R-squared:  0.9596,  Adjusted R-squared:  0.9529
F-statistic: 142.5 on 3 and 18 DF,  p-value: 9.905e-13
```

```
Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ SH.IMM.MEAS + SH.DTH.NMRT +
    time, data = health.new[, GA.health@solution == 1])

Residuals:
      Min        1Q    Median        3Q       Max
-0.21053  -0.07867   0.00842   0.06612   0.26069

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.510e+01  8.420e-01  17.939 6.24e-13 ***
SH.IMM.MEAS  2.919e-02  5.325e-03   5.482 3.31e-05 ***
SH.DTH.NMRT -3.194e-04  2.162e-05 -14.772 1.66e-11 ***
time        -3.188e-01  1.153e-02 -27.647 3.39e-16 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.1294 on 18 degrees of freedom
Multiple R-squared:  0.9891,  Adjusted R-squared:  0.9873
F-statistic: 543.5 on 3 and 18 DF,  p-value: < 2.2e-16


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ SH.IMM.MEAS + SH.DTH.NMRT +
    time, data = health.new[, GA.health@solution == 1])

Residuals:
       Min         1Q     Median         3Q        Max
-0.026174 -0.013788  0.003766  0.009219  0.033587

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.174e+01  1.038e-01 498.300  < 2e-16 ***
SH.IMM.MEAS -2.790e-03  6.566e-04  -4.249 0.000482 ***
SH.DTH.NMRT -3.215e-05  2.666e-06 -12.061 4.65e-10 ***
time        -9.666e-03  1.422e-03  -6.798 2.29e-06 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.01596 on 18 degrees of freedom
Multiple R-squared:  0.9106,  Adjusted R-squared:  0.8957
F-statistic: 61.11 on 3 and 18 DF,  p-value: 1.234e-09
```

```
96
97
98  Response SP.DYN.LE00.FE.IN :
99
100 Call:
101 lm(formula = SP.DYN.LE00.FE.IN ~ SH.IMM.MEAS + SH.DTH.NMRT +
102     time, data = health.new[, GA.health@solution == 1])
103
104 Residuals:
105      Min       1Q   Median       3Q      Max
106 -1.42478 -0.26787  0.00613  0.38213  0.70644
107
108 Coefficients:
109              Estimate Std. Error t value Pr(>|t|)
110 (Intercept) 3.065e+01  3.647e+00   8.404 1.21e-07 ***
111 SH.IMM.MEAS 8.961e-02  2.306e-02   3.886  0.00108 **
112 SH.DTH.NMRT 4.970e-04  9.363e-05   5.308 4.79e-05 ***
113 time        6.115e-01  4.993e-02  12.247 3.63e-10 ***
114 ---
115 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
116
117 Residual standard error: 0.5606 on 18 degrees of freedom
118 Multiple R-squared:  0.9766,  Adjusted R-squared:  0.9727
119 F-statistic: 250.1 on 3 and 18 DF,  p-value: 7.42e-15
120
121
122 Response SL.AGR.EMPL.FE.ZS :
123
124 Call:
125 lm(formula = SL.AGR.EMPL.FE.ZS ~ SH.IMM.MEAS + SH.DTH.NMRT +
126     time, data = health.new[, GA.health@solution == 1])
127
128 Residuals:
129      Min       1Q   Median       3Q      Max
130 -0.57762 -0.13832  0.01139  0.08716  0.91109
131
132 Coefficients:
133              Estimate Std. Error t value Pr(>|t|)
134 (Intercept)  5.796e+01  2.011e+00  28.818   <2e-16 ***
135 SH.IMM.MEAS -9.391e-03  1.272e-02  -0.738    0.470
136 SH.DTH.NMRT -5.603e-05  5.164e-05  -1.085    0.292
137 time        -9.607e-01  2.754e-02 -34.885   <2e-16 ***
138 ---
139 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
140
141 Residual standard error: 0.3091 on 18 degrees of freedom
142 Multiple R-squared:  0.9978,  Adjusted R-squared:  0.9975
143 F-statistic:  2772 on 3 and 18 DF,  p-value: < 2.2e-16
```

```
144
145
146 Response SL.IND.EMPL.FE.ZS :
147
148 Call:
149 lm(formula = SL.IND.EMPL.FE.ZS ~ SH.IMM.MEAS + SH.DTH.NMRT +
150     time, data = health.new[, GA.health@solution == 1])
151
152 Residuals:
153      Min       1Q   Median       3Q      Max
154 -0.21364 -0.10827 -0.03111  0.11755  0.24722
155
156 Coefficients:
157               Estimate Std. Error t value Pr(>|t|)
158 (Intercept)  1.707e+01  1.070e+00  15.963 4.53e-12 ***
159 SH.IMM.MEAS -2.163e-02  6.764e-03  -3.198  0.00498 **
160 SH.DTH.NMRT -2.277e-04  2.746e-05  -8.291 1.47e-07 ***
161 time         7.381e-02  1.465e-02   5.040 8.52e-05 ***
162 ---
163 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
164
165 Residual standard error: 0.1644 on 18 degrees of freedom
166 Multiple R-squared:  0.9772,  Adjusted R-squared:  0.9734
167 F-statistic: 256.9 on 3 and 18 DF,  p-value: 5.863e-15
168
169
170 Response SL.FAM.WORK.FE.ZS :
171
172 Call:
173 lm(formula = SL.FAM.WORK.FE.ZS ~ SH.IMM.MEAS + SH.DTH.NMRT +
174     time, data = health.new[, GA.health@solution == 1])
175
176 Residuals:
177     Min      1Q  Median      3Q     Max
178 -2.0844 -0.4354  0.2507  0.5547  1.0103
179
180 Coefficients:
181               Estimate Std. Error t value Pr(>|t|)
182 (Intercept)  1.364e+02  5.605e+00  24.334 3.18e-15 ***
183 SH.IMM.MEAS  8.812e-02  3.545e-02   2.486    0.023 *
184 SH.DTH.NMRT -2.628e-03  1.439e-04 -18.258 4.62e-13 ***
185 time        -1.956e+00  7.675e-02 -25.484 1.42e-15 ***
186 ---
187 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
188
189 Residual standard error: 0.8616 on 18 degrees of freedom
190 Multiple R-squared:  0.9844,  Adjusted R-squared:  0.9817
191 F-statistic: 377.5 on 3 and 18 DF,  p-value: < 2.2e-16
```

```
Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ SH.IMM.MEAS + SH.DTH.NMRT +
    time, data = health.new[, GA.health@solution == 1])

Residuals:
      Min        1Q    Median        3Q       Max
-0.58238 -0.12951 -0.01323  0.17635  0.37864

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.063e+00  1.736e+00   3.492  0.00260 **
SH.IMM.MEAS  2.455e-02  1.098e-02   2.237  0.03821 *
SH.DTH.NMRT -1.146e-04  4.457e-05  -2.571  0.01923 *
time        -1.085e-01  2.377e-02  -4.564  0.00024 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2669 on 18 degrees of freedom
Multiple R-squared:  0.6178,  Adjusted R-squared:  0.554
F-statistic: 9.697 on 3 and 18 DF,  p-value: 0.000497
```

Table 20: Summary of Education Model

```
> summary(edu.ga)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
       Min         1Q     Median         3Q        Max
-0.116110 -0.025707  0.002508  0.019938  0.102621

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.299685   0.178273  29.728  < 2e-16 ***
SE.COM.DURS       -0.039540   0.010786  -3.666  0.00177 **
NY.ADJ.AEDU.GN.ZS  0.046544   0.024490   1.901  0.07350 .
time              -0.078676   0.003417 -23.026 8.35e-15 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.05105 on 18 degrees of freedom
```

```
Multiple R-squared:  0.9938,  Adjusted R-squared:  0.9928
F-statistic: 964.7 on 3 and 18 DF,  p-value: < 2.2e-16


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
    Min      1Q  Median      3Q     Max
-20.160 -10.892  -2.921   9.582  39.315

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        338.787     54.886   6.173 7.93e-06 ***
SE.COM.DURS          5.748      3.321   1.731    0.101
NY.ADJ.AEDU.GN.ZS    7.245      7.540   0.961    0.349
time                -7.795      1.052  -7.410 7.17e-07 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 15.72 on 18 degrees of freedom
Multiple R-squared:  0.9018,  Adjusted R-squared:  0.8854
F-statistic: 55.07 on 3 and 18 DF,  p-value: 2.869e-09


Response SH.HIV.1524.FE.ZS :

Call:
lm(formula = SH.HIV.1524.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.33916 -0.14846 -0.03319  0.10924  0.55419

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        8.36441    0.85899   9.737 1.34e-08 ***
SE.COM.DURS        0.16626    0.05197   3.199  0.00497 **
NY.ADJ.AEDU.GN.ZS -0.66305    0.11800  -5.619 2.48e-05 ***
time              -0.24724    0.01646 -15.017 1.26e-11 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.246 on 18 degrees of freedom
```

```
Multiple R-squared:  0.9606,  Adjusted R-squared:  0.954
F-statistic: 146.1 on 3 and 18 DF,  p-value: 8e-13


Response SP.POP.TOTL.FE.ZS :

Call:
lm(formula = SP.POP.TOTL.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
      Min        1Q    Median        3Q       Max
-0.080059 -0.028764 -0.002291  0.030843  0.081316

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       50.290501   0.157931 318.434   <2e-16 ***
SE.COM.DURS        0.022353   0.009555   2.339   0.0310 *
NY.ADJ.AEDU.GN.ZS -0.016113   0.021695  -0.743   0.4672
time              -0.006349   0.003027  -2.098   0.0503 .
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.04523 on 18 degrees of freedom
Multiple R-squared:  0.282, Adjusted R-squared:  0.1624
F-statistic: 2.357 on 3 and 18 DF,  p-value: 0.1059


Response SP.DYN.LE00.FE.IN :

Call:
lm(formula = SP.DYN.LE00.FE.IN ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
    Min      1Q  Median      3Q     Max
-2.6986 -0.5411  0.2175  0.5417  1.2891

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       59.71127    3.52574  16.936 1.66e-12 ***
SE.COM.DURS       -0.37095    0.21331  -1.739   0.0991 .
NY.ADJ.AEDU.GN.ZS -0.25611    0.48434  -0.529   0.6034
time               0.58073    0.06758   8.594 8.71e-08 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 1.01 on 18 degrees of freedom
```

```
Multiple R-squared:  0.924, Adjusted R-squared:  0.9113
F-statistic: 72.93 on 3 and 18 DF,  p-value: 2.882e-10


Response SL.AGR.EMPL.FE.ZS :

Call:
lm(formula = SL.AGR.EMPL.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.48126 -0.17691 -0.01688  0.08453  1.02759

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       55.86394    1.12206  49.787   <2e-16 ***
SE.COM.DURS       -0.04418    0.06789  -0.651    0.523
NY.ADJ.AEDU.GN.ZS -0.06372    0.15414  -0.413    0.684
time              -0.93948    0.02151 -43.685   <2e-16 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.3213 on 18 degrees of freedom
Multiple R-squared:  0.9977,  Adjusted R-squared:  0.9973
F-statistic:  2565 on 3 and 18 DF,  p-value: < 2.2e-16


Response SL.IND.EMPL.FE.ZS :

Call:
lm(formula = SL.IND.EMPL.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.56058 -0.25301  0.01129  0.23365  0.57341

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        7.25328    1.24894   5.808 1.68e-05 ***
SE.COM.DURS        0.12463    0.07556   1.649 0.116433
NY.ADJ.AEDU.GN.ZS -0.17152    0.17157  -1.000 0.330696
time               0.10088    0.02394   4.214 0.000521 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.3577 on 18 degrees of freedom
```

```
Multiple R-squared:  0.892, Adjusted R-squared:  0.874
F-statistic: 49.55 on 3 and 18 DF,  p-value: 6.701e-09


Response SL.FAM.WORK.FE.ZS :

Call:
lm(formula = SL.FAM.WORK.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
   Min     1Q Median     3Q    Max
-3.170 -1.580 -0.148  1.675  4.070

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        62.9143     8.1640   7.706 4.16e-07 ***
SE.COM.DURS         1.4486     0.4939   2.933 0.008892 **
NY.ADJ.AEDU.GN.ZS  -4.4298     1.1215  -3.950 0.000939 ***
time               -1.4720     0.1565  -9.407 2.27e-08 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 2.338 on 18 degrees of freedom
Multiple R-squared:  0.8848,  Adjusted R-squared:  0.8656
F-statistic: 46.09 on 3 and 18 DF,  p-value: 1.192e-08


Response SH.STA.SUIC.FE.P5 :

Call:
lm(formula = SH.STA.SUIC.FE.P5 ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
     Min       1Q   Median       3Q      Max
-0.47702 -0.15442 -0.01417  0.10004  0.37783

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        6.37619    0.82491   7.730 3.99e-07 ***
SE.COM.DURS        0.01254    0.04991   0.251 0.804387
NY.ADJ.AEDU.GN.ZS -0.46465    0.11332  -4.100 0.000672 ***
time              -0.07073    0.01581  -4.474 0.000294 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.2362 on 18 degrees of freedom
```

```
Multiple R-squared:  0.7004,  Adjusted R-squared:  0.6505
F-statistic: 14.03 on 3 and 18 DF,  p-value: 5.849e-05
```

Table 21: Summary of Technology Model

```
> summary(tech.ga)
Response SP.DYN.TFRT.IN :

Call:
lm(formula = SP.DYN.TFRT.IN ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
      Min        1Q    Median        3Q       Max
-0.116110 -0.025707  0.002508  0.019938  0.102621

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.299685   0.178273  29.728  < 2e-16 ***
SE.COM.DURS       -0.039540   0.010786  -3.666  0.00177 **
NY.ADJ.AEDU.GN.ZS  0.046544   0.024490   1.901  0.07350 .
time              -0.078676   0.003417 -23.026 8.35e-15 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1

Residual standard error: 0.05105 on 18 degrees of freedom
Multiple R-squared:  0.9938,  Adjusted R-squared:  0.9928
F-statistic: 964.7 on 3 and 18 DF,  p-value: < 2.2e-16


Response SP.DYN.AMRT.FE :

Call:
lm(formula = SP.DYN.AMRT.FE ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
    time, data = edu.new[, GA.edu@solution == 1])

Residuals:
    Min      1Q  Median      3Q     Max
-20.160 -10.892  -2.921   9.582  39.315

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        338.787     54.886   6.173 7.93e-06 ***
SE.COM.DURS          5.748      3.321   1.731    0.101
NY.ADJ.AEDU.GN.ZS    7.245      7.540   0.961    0.349
time                -7.795      1.052  -7.410 7.17e-07 ***
---
Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
           1
```

```
44
45 Residual standard error: 15.72 on 18 degrees of freedom
46 Multiple R-squared:  0.9018,  Adjusted R-squared:  0.8854
47 F-statistic: 55.07 on 3 and 18 DF,  p-value: 2.869e-09
48
49
50 Response SH.HIV.1524.FE.ZS :
51
52 Call:
53 lm(formula = SH.HIV.1524.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
54     time, data = edu.new[, GA.edu@solution == 1])
55
56 Residuals:
57      Min       1Q   Median       3Q      Max
58 -0.33916 -0.14846 -0.03319  0.10924  0.55419
59
60 Coefficients:
61                   Estimate Std. Error t value Pr(>|t|)
62 (Intercept)         8.36441    0.85899   9.737 1.34e-08 ***
63 SE.COM.DURS         0.16626    0.05197   3.199  0.00497 **
64 NY.ADJ.AEDU.GN.ZS -0.66305    0.11800  -5.619 2.48e-05 ***
65 time               -0.24724    0.01646 -15.017 1.26e-11 ***
66 ---
67 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
               1
68
69 Residual standard error: 0.246 on 18 degrees of freedom
70 Multiple R-squared:  0.9606,  Adjusted R-squared:  0.954
71 F-statistic: 146.1 on 3 and 18 DF,  p-value: 8e-13
72
73
74 Response SP.POP.TOTL.FE.ZS :
75
76 Call:
77 lm(formula = SP.POP.TOTL.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
78     time, data = edu.new[, GA.edu@solution == 1])
79
80 Residuals:
81       Min         1Q     Median         3Q        Max
82 -0.080059 -0.028764 -0.002291  0.030843  0.081316
83
84 Coefficients:
85                    Estimate Std. Error t value Pr(>|t|)
86 (Intercept)        50.290501   0.157931 318.434   <2e-16 ***
87 SE.COM.DURS         0.022353   0.009555   2.339   0.0310 *
88 NY.ADJ.AEDU.GN.ZS -0.016113   0.021695  -0.743   0.4672
89 time               -0.006349   0.003027  -2.098   0.0503 .
90 ---
91 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
               1
```

```
92
93 Residual standard error: 0.04523 on 18 degrees of freedom
94 Multiple R-squared:  0.282, Adjusted R-squared:  0.1624
95 F-statistic: 2.357 on 3 and 18 DF,  p-value: 0.1059
96
97
98 Response SP.DYN.LE00.FE.IN :
99
100 Call:
101 lm(formula = SP.DYN.LE00.FE.IN ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
102     time, data = edu.new[, GA.edu@solution == 1])
103
104 Residuals:
105     Min      1Q  Median      3Q     Max
106 -2.6986 -0.5411  0.2175  0.5417  1.2891
107
108 Coefficients:
109                   Estimate Std. Error t value Pr(>|t|)
110 (Intercept)       59.71127    3.52574  16.936 1.66e-12 ***
111 SE.COM.DURS       -0.37095    0.21331  -1.739   0.0991 .
112 NY.ADJ.AEDU.GN.ZS -0.25611    0.48434  -0.529   0.6034
113 time               0.58073    0.06758   8.594 8.71e-08 ***
114 ---
115 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
116
117 Residual standard error: 1.01 on 18 degrees of freedom
118 Multiple R-squared:  0.924, Adjusted R-squared:  0.9113
119 F-statistic: 72.93 on 3 and 18 DF,  p-value: 2.882e-10
120
121
122 Response SL.AGR.EMPL.FE.ZS :
123
124 Call:
125 lm(formula = SL.AGR.EMPL.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
126     time, data = edu.new[, GA.edu@solution == 1])
127
128 Residuals:
129      Min       1Q   Median       3Q      Max
130 -0.48126 -0.17691 -0.01688  0.08453  1.02759
131
132 Coefficients:
133                   Estimate Std. Error t value Pr(>|t|)
134 (Intercept)       55.86394    1.12206  49.787   <2e-16 ***
135 SE.COM.DURS       -0.04418    0.06789  -0.651    0.523
136 NY.ADJ.AEDU.GN.ZS -0.06372    0.15414  -0.413    0.684
137 time              -0.93948    0.02151 -43.685   <2e-16 ***
138 ---
139 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
```

```
140
141 Residual standard error: 0.3213 on 18 degrees of freedom
142 Multiple R-squared:  0.9977,  Adjusted R-squared:  0.9973
143 F-statistic:  2565 on 3 and 18 DF,  p-value: < 2.2e-16
144
145
146 Response SL.IND.EMPL.FE.ZS :
147
148 Call:
149 lm(formula = SL.IND.EMPL.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
150     time, data = edu.new[, GA.edu@solution == 1])
151
152 Residuals:
153      Min       1Q   Median       3Q      Max
154 -0.56058 -0.25301  0.01129  0.23365  0.57341
155
156 Coefficients:
157                   Estimate Std. Error t value Pr(>|t|)
158 (Intercept)        7.25328    1.24894   5.808 1.68e-05 ***
159 SE.COM.DURS        0.12463    0.07556   1.649 0.116433
160 NY.ADJ.AEDU.GN.ZS -0.17152    0.17157  -1.000 0.330696
161 time               0.10088    0.02394   4.214 0.000521 ***
162 ---
163 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
164
165 Residual standard error: 0.3577 on 18 degrees of freedom
166 Multiple R-squared:  0.892, Adjusted R-squared:  0.874
167 F-statistic: 49.55 on 3 and 18 DF,  p-value: 6.701e-09
168
169
170 Response SL.FAM.WORK.FE.ZS :
171
172 Call:
173 lm(formula = SL.FAM.WORK.FE.ZS ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
174     time, data = edu.new[, GA.edu@solution == 1])
175
176 Residuals:
177    Min     1Q Median     3Q    Max
178 -3.170 -1.580 -0.148  1.675  4.070
179
180 Coefficients:
181                   Estimate Std. Error t value Pr(>|t|)
182 (Intercept)        62.9143     8.1640   7.706 4.16e-07 ***
183 SE.COM.DURS         1.4486     0.4939   2.933 0.008892 **
184 NY.ADJ.AEDU.GN.ZS  -4.4298     1.1215  -3.950 0.000939 ***
185 time               -1.4720     0.1565  -9.407 2.27e-08 ***
186 ---
187 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
```

```
188
189 Residual standard error: 2.338 on 18 degrees of freedom
190 Multiple R-squared:  0.8848,  Adjusted R-squared:  0.8656
191 F-statistic: 46.09 on 3 and 18 DF,  p-value: 1.192e-08
192
193
194 Response SH.STA.SUIC.FE.P5 :
195
196 Call:
197 lm(formula = SH.STA.SUIC.FE.P5 ~ SE.COM.DURS + NY.ADJ.AEDU.GN.ZS +
198     time, data = edu.new[, GA.edu@solution == 1])
199
200 Residuals:
201      Min       1Q   Median       3Q      Max
202 -0.47702 -0.15442 -0.01417  0.10004  0.37783
203
204 Coefficients:
205                   Estimate Std. Error t value Pr(>|t|)
206 (Intercept)        6.37619    0.82491   7.730 3.99e-07 ***
207 SE.COM.DURS         0.01254    0.04991   0.251 0.804387
208 NY.ADJ.AEDU.GN.ZS -0.46465    0.11332  -4.100 0.000672 ***
209 time               -0.07073    0.01581  -4.474 0.000294 ***
210 ---
211 Signif. codes:  0    ***    0.001    **    0.01    *    0.05    .    0.1
            1
212
213 Residual standard error: 0.2362 on 18 degrees of freedom
214 Multiple R-squared:  0.7004,  Adjusted R-squared:  0.6505
215 F-statistic: 14.03 on 3 and 18 DF,  p-value: 5.849e-05
```