INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

DEPARTMENT
OF
INDUSTRIAL AND MANAGEMENT ENGINEERING

MBA652A
STATISTICAL MODELLING FOR BUSINESSS ANALYSIS

PANEL DATA ANALYSIS

STATISTICAL ANALYSIS ON FACTORS AFFECTING LIFE EXPECTENCY

Submitted By- **(Group 7)**

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The Research

Although there have been lot of studies undertaken in the past on factors affecting life expectancy considering demographic variables, income composition and mortality rates. It was found that affect of immunization and human development index was not taken into account in the past. Also, some of the past research was done considering multiple linear regression based on data set of one year for all the countries. Hence, this gives motivation to resolve both the factors stated previously by formulating a regression model based on mixed effects model and multiple linear regression while considering data from a period of 2000 to 2015 for all the countries. Important immunization like Hepatitis B, Polio and Diphtheria will also be considered. In a nutshell, this study will focus on immunization factors, mortality factors, economic factors, social factors and other health related factors as well. Since the observations this dataset are based on different countries, it will be easier for a country to determine the predicting factor which is contributing to lower value of life expectancy. This will help in suggesting a country which area should be given importance in order to efficiently improve the life expectancy of its population.

Executive Summary

The project relies on accuracy of data. The Global Health Observatory (GHO) data repository under World Health Organization (WHO) keeps track of the health status as well as many other related factors for all countries The data-sets are made available to public for the purpose of health data analysis. The data-set related to life expectancy, health factors for 193 countries has been collected from the same WHO data repository website and its corresponding economic data was collected from United Nation website. Among all categories of health-related factors only those critical factors were chosen which are more representative. It has been observed that in the past 15 years , there has been a huge development in health sector resulting in improvement of human mortality rates especially in the developing nations in comparison to the past 30 years. Therefore, in this project we have considered data from year 2000-2015 for 193 countries for further analysis. The individual data files have been merged together into a single data-set. On initial visual inspection of the data showed some missing values. As the data-sets were from WHO, we found no evident errors. Missing data was handled in R software by using Missmap command. The result indicated that most of the missing data was for population, Hepatitis B and GDP. The missing data were from less known countries like Vanuatu, Tonga, Togo, Cabo Verde etc. Finding all data for these countries was difficult and hence, it was decided that we exclude these countries from the final model data-set. The final merged file(final dataset) consists of 22 Columns and 2938 rows which meant 20 predicting variables. All predicting variables was then divided into several broad categories:Immunization related factors, Mortality factors, Economical factors and Social factors.

The Data

Source

https://www.kaggle.com/kumarajarshi/life-expectancy-who?select=Life+Expectancy+Data.csv

Description

Our data set is a Panel Data set. A panel data set, also called longitudinal data set, is one that studies the same parameters at different points in time. It has a total of 2398 observations studied over 16 years for 193 Countries. The balance in the dataset is established as there are no missing values.

It has statistics about the spot exchange rates (the logarithmic function of the exchange rate), the long and short-term interest rates in the US, the long and the short-term interest rates in the respective country, the price level (the logarithmic function of price level) of a basket of goods in the respective country.

Variables

Country	Year
Status	Life.expectancy
Adult.Mortality	infant.deaths
Alcohol	percentage.expenditure
Hepatitis.B	Measles
BMI	under.five.deaths
Polio	Total.expenditure
Diphtheria	HIV.AIDS
GDP	Population
thinness..1.19.years	thinness.5.9.years
Income.composition.of.resources	Schooling
avg	

Dependent Variables and Independent Variables

Dependent Variable: **Life Expectancy**

The dependent variable is the one being tested and measured and whose value may be affected by the change of other independent variables. We will examine the effect of other variables on the life expectancy

Independent Variables:

An independent variable is a variable that is changed or varied in an experiment to examine the effect on dependent variable. In our analysis, we are taking the other above variables as the independent ones. We believe that comparing these variables with dependent variable might suggest the effect that they have on the dependent variable.

Descriptive Statistics

```
    Country                     Year             Status
  Afghanistan        :  16   2013   : 193    Developed: 508
   Albania           :  16   2000   : 183    Developing: 2417
   Algeria           :  16   2002   : 183
   Angola            :  16   2004   : 183
  Antigua and Barbuda:  16   2005   : 183
   Argentina         :  16   2006   : 183
   (Other)           :2829   (Other):1817


Life.expectancy    Adult.Mortality  infant.deaths        Alcohol
  Min.   :36.30   Min.   :  1.0   Min.   :   0.00   Min.   : 0.010
  1st Qu.:63.00   1st Qu.: 74.0   1st Qu.:   0.00   1st Qu.: 0.860
  Median :72.00   Median :144.0   Median :   3.00   Median : 3.810
  Mean   :69.19   Mean   :165.2   Mean   :  30.39   Mean   : 4.639
  3rd Qu.:75.60   3rd Qu.:228.0   3rd Qu.:  22.00   3rd Qu.: 7.840
  Max.   :89.00   Max.   :723.0   Max.   :1800.00   Max.   :17.870



percentage.expenditure     Measles              BMI         Total.expenditure
```

```
Min.   :    0.000        Min.   :     0   Min.   : 1.00   Min.   : 0.370
1st Qu.:    5.235        1st Qu.:     0   1st Qu.:19.10   1st Qu.: 4.260
Median :   66.378        Median :    17   Median :43.50   Median : 5.710
Mean   :  741.532        Mean   :  2427   Mean   :38.24   Mean   : 5.913
3rd Qu.:  443.475        3rd Qu.:   362   3rd Qu.:56.10   3rd Qu.: 7.470
Max.   :19479.912        Max.   :212183   Max.   :87.30   Max.   :17.600

  Diphtheria       HIV.AIDS      thinness..1.19.years
Min.   : 2.00   Min.   : 0.100   Min.   : 0.100
1st Qu.:78.00   1st Qu.: 0.100   1st Qu.: 1.600
Median :93.00   Median : 0.100   Median : 3.300
Mean   :82.22   Mean   : 1.746   Mean   : 4.892
3rd Qu.:97.00   3rd Qu.: 0.800   3rd Qu.: 7.200
Max.   :99.00   Max.   :50.600   Max.   :27.700

Income.composition.of.resources   Schooling
Min.   :0.0000                  Min.   : 0.00
1st Qu.:0.4940                1st Qu.:10.10
Median :0.6810                Median :12.30
Mean   :0.6302                Mean   :12.02
3rd Qu.:0.7810                3rd Qu.:14.30
Max.   :0.9480                Max.   :20.70
```

Heterogeneity

The data is checked for heterogeneity, the functions “ggplot”, “plotmeans” were used. Relationship between Y and X variables for the cross- section of the 17 entities quarterly across 26 years. Scatter plots have been used to identify any existence of correlation between the quantitative variables.

Figure 1: Variation of Life Expectancy across countries

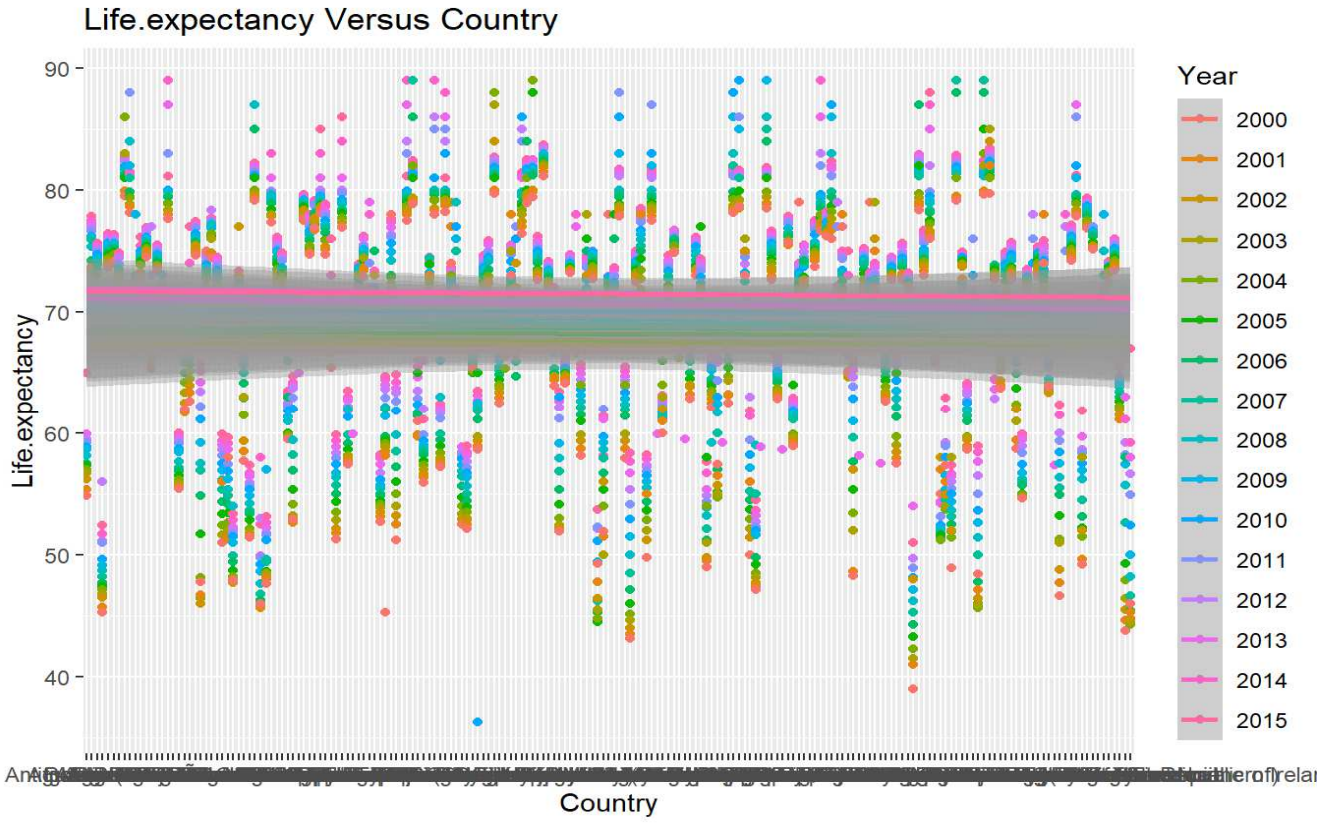


Figure 2: Heterogeneity across Years

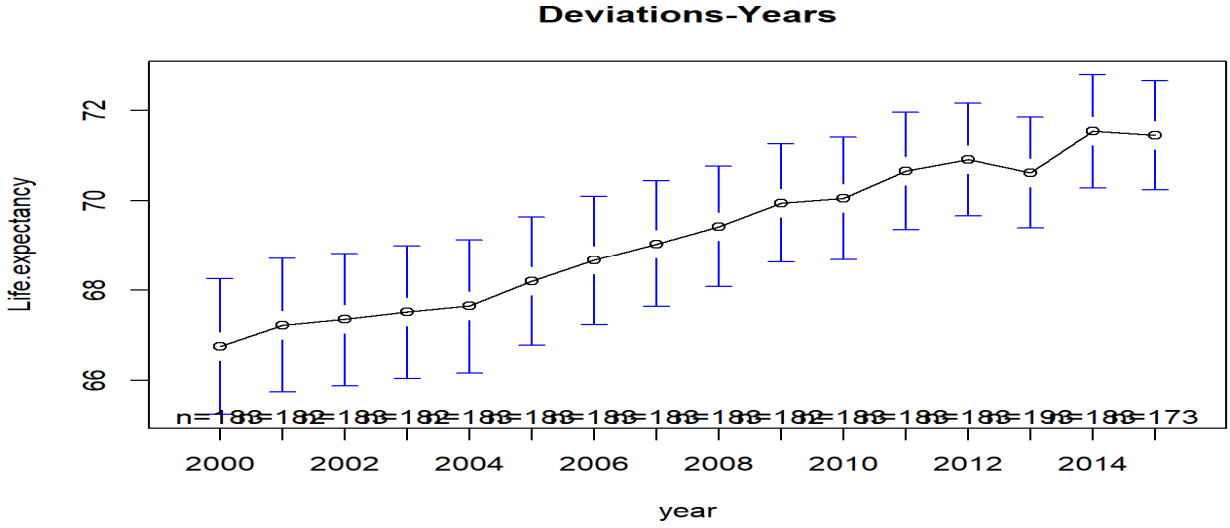
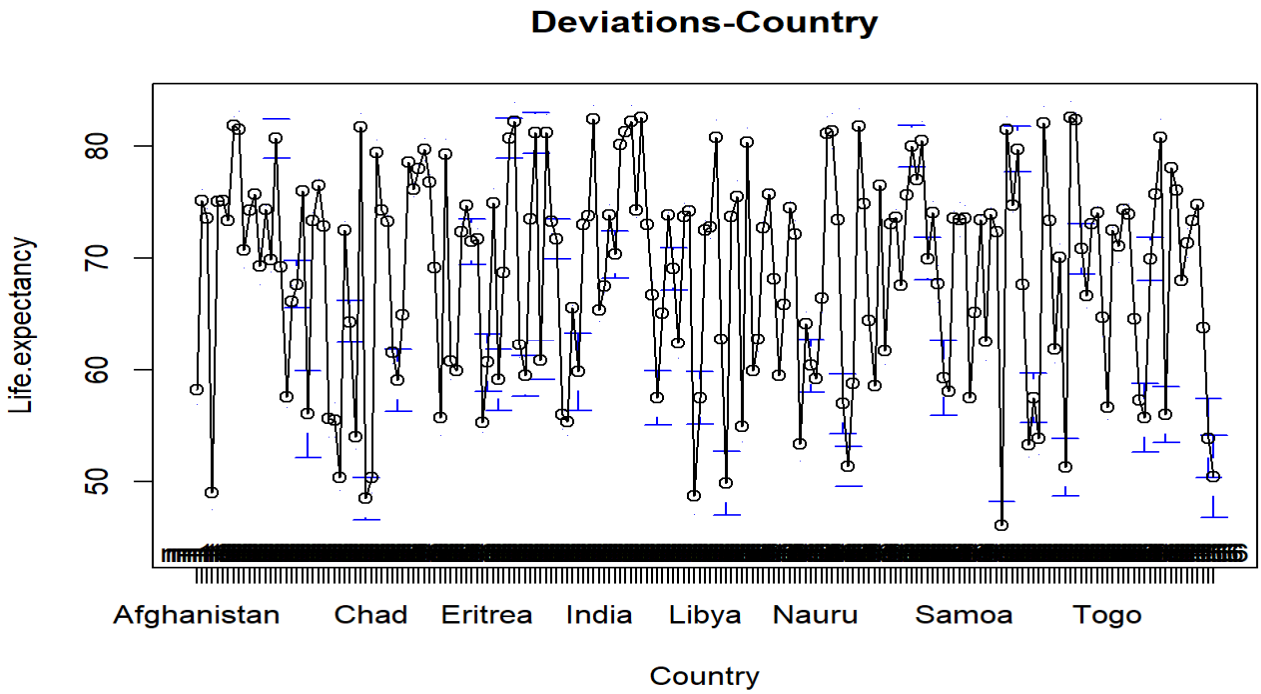
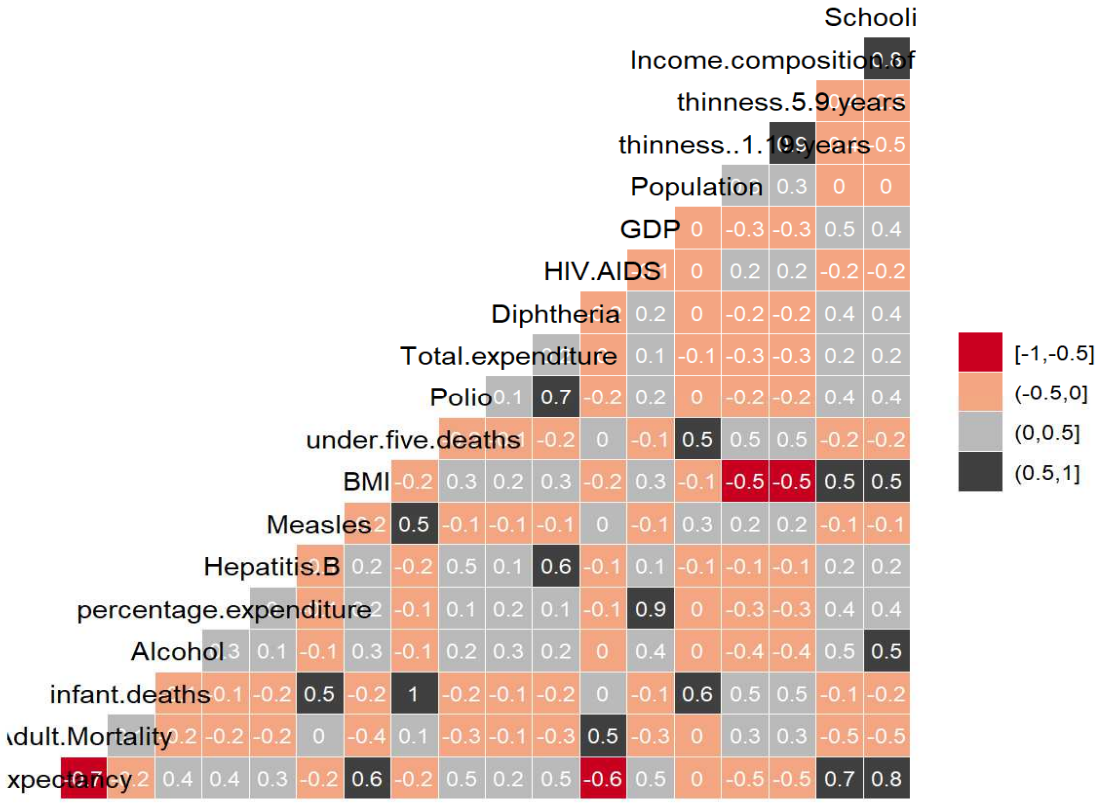


Figure 3: Heterogeneity across Countries



Correlation Matrix :



With the help of Correlation matrix , we removed Hepatitis , under. five, Polio, GDP, Population**,** thinness 5 years because of high correlation .

Panel Data Analysis

Panel data sets, or a longitudinal data set, is a set of cross-sectional data collected for the same parameters across various years. For the analysis of the panel dataset in hand, we have employed the following regression techniques:

1. Pooled Regression
2. Fixed Effects Regression
    I. Entity Fixed Effects
        i. Entity Fixed Effects (Entity demeaned)
        ii. Entity Fixed Effects with significantVariables
    II. Entity Fixed Effects using Binary Variables
    III.Time Fixed Effects
    IV.Entity and Time Fixed Effects
3. Random Effect model

The statistical modelling has been done in the R software using the PLM function. This function is used for linear modelling of panel data. or first model we regress Life expectancy against schooling.

Pooled Regression Models

The pooled regression model ignores any differences over entities or time and treats each data as a separate entity. We use the “plm” function to carry out pooled regression on the data in R. We made 7 models by forward regression starting from schooling because of high significance.We are showing the final pooled model.

Final Model

```
Pooling Model

## plm(formula = Life.expectancy ~ Schooling + Income.composition.of.resources +
##     BMI + percentage.expenditure + HIV.AIDS + thinness..1.19.years +
##     Diphtheria, data = Pooled_Data, model = "pooling")
## Unbalanced Panel: n = 193, T = 1-16, N = 2925
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -27.77658  -2.78594   0.12939   2.65059  27.05782
##
## Coefficients:
##                                  Estimate  Std. Error  t-value  Pr(>|t|)
## (Intercept)                     4.8030e+01  4.9899e-01  96.2540 < 2.2e-16
## Schooling                       8.1468e-01  4.4181e-02  18.4393 < 2.2e-16
```

```
## Income.composition.of.resources  7.6556e+00  7.0037e-01  10.9308 < 2.2e-16
## BMI                              6.1836e-02  5.6500e-03  10.9444 < 2.2e-16
## percentage.expenditure           5.1861e-04  4.8212e-05  10.7569 < 2.2e-16
## HIV.AIDS                        -6.8896e-01  1.8136e-02 -37.9883 < 2.2e-16
## thinness..1.19.years            -1.2304e-01  2.4047e-02  -5.1167 3.311e-07
## Diphtheria                       6.8059e-02  4.1005e-03  16.5980 < 2.2e-16
##
## (Intercept)                     ***
## Schooling                       ***
## Income.composition.of.resources ***
## BMI                             ***
## percentage.expenditure          ***
## HIV.AIDS                        ***
## thinness..1.19.years            ***
## Diphtheria                      ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    264660
## Residual Sum of Squares: 66239
## R-Squared:      0.74972
## Adj. R-Squared: 0.74912
## F-statistic: 1248.3 on 7 and 2917 DF, p-value: < 2.22e-16
```

Analysis

This model has a decent adjusted R^2 , but we'll try to build some more models which will handle the time or entity specific effects, that we might have missed in this model.

Fixed Regression Models

Entity Fixed Effects (Entity demeaned)

In entity fixed models, each country is considered as a separate entity. In entity demeaned method, all the values across the years, for each country are averaged and the average is then subtracted from ther respective observations. This way, we obtain the entity demeaned observations which are then regressed. Here, we have regressed the life expectance over all the independent variables. We started with one variable and by forward regression our final model results are described below

Final Model

```
## Oneway (individual) effect Within Model

## plm(formula = Life.expectancy ~ Schooling + HIV.AIDS + Diphtheria +

##     infant.deaths + Adult.Mortality + Alcohol + Measles +
Income.composition.of.resources,

##     data = Pooled_Data, effect = "individual", model = "within")

## Unbalanced Panel: n = 193, T = 1-16, N = 2925

## Residuals:

##      Min.   1st Qu.    Median   3rd Qu.      Max.

## -22.95693  -0.99549  -0.16796   0.66764  10.44901

## Coefficients:

##                                    Estimate  Std. Error  t-value  Pr(>|t|)

## Schooling                          4.7687e-01  3.4734e-02  13.7295 < 2.2e-16

## HIV.AIDS                          -4.2978e-01  1.6335e-02 -26.3108 < 2.2e-16

## Diphtheria                         1.4793e-02  2.3369e-03   6.3300 2.858e-10

## infant.deaths                     -8.5933e-03  1.6838e-03  -5.1035 3.564e-07

## Adult.Mortality                   -2.4614e-03  5.0977e-04  -4.8286 1.451e-06

## Alcohol                           -8.7181e-02  2.1725e-02  -4.0129 6.161e-05

## Measles                           -2.1507e-05  4.8608e-06  -4.4246 1.004e-05

## Income.composition.of.resources    2.0060e+00  4.4190e-01   4.5394 5.887e-06

## Schooling                         ***

## HIV.AIDS                          ***

## Diphtheria                        ***

## infant.deaths                     ***

## Adult.Mortality                   ***

## Alcohol                           ***

## Measles                           ***

## Income.composition.of.resources ***
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## Total Sum of Squares:    19571

## Residual Sum of Squares: 12352

## R-Squared:      0.36886

## Adj. R-Squared: 0.32252

## F-statistic: 199.002 on 8 and 2724 DF, p-value: < 2.22e-16
```

Analysis

This model has a decent adjusted R^2, but we'll try to build some more models which will handle the time or entity specific effects, that we might have missed in this model.

Entity Fixed Effects (Binary Regressor)

Model 1(Binary Regressor for each country)

In this model, we have a binary variable for each of the 195 countries. Each countries table is too large so we are showing some results only.

```
## Residual standard error: 2.165 on 2727 degrees of freedom

## Multiple R-squared:  0.9517, Adjusted R-squared:  0.9482

## F-statistic: 272.8 on 197 and 2727 DF, p-value: < 2.2e-16
```

Analysis

This model has a high adjusted R^2, but only the entity fixed effects have been handled. In next model we'll try to handle the time fixed effects.

Time Fixed Effects (Time demeaned)

Model 1

In time fixed models, variations across the time are taken into consideration but not across entities. For each time period the values are averaged, and the average is then subtracted from the observations of the entity. This way, we obtain the time demeaned observations which are then regressed. Here, we have regressed the life expectance over the independent variables.

```
## Oneway (time) effect Within Model

## plm(formula = Life.expectancy ~ Schooling + HIV.AIDS + Income.composition.of.resources
+

##     BMI + Diphtheria + Measles + percentage.expenditure + Adult.Mortality +

##     Alcohol, data = Pooled_Data, effect = "time", model = "within")

## Unbalanced Panel: n = 193, T = 1-16, N = 2925

## Residuals:
```

```
##       Min.    1st Qu.     Median    3rd Qu.       Max.
## -22.984437  -2.202750   0.010137   2.389799  23.090898
## Coefficients:
##                                   Estimate  Std. Error  t-value  Pr(>|t|)
## Schooling                         6.9727e-01  4.1268e-02  16.8962 < 2.2e-16
## HIV.AIDS                         -4.8279e-01  1.8578e-02 -25.9870 < 2.2e-16
## Income.composition.of.resources   6.3657e+00  6.4095e-01   9.9316 < 2.2e-16
## BMI                               5.1696e-02  4.8405e-03  10.6798 < 2.2e-16
## Diphtheria                        5.9902e-02  3.7417e-03  16.0092 < 2.2e-16
## Measles                          -3.4211e-05  7.1048e-06  -4.8152 1.546e-06
## percentage.expenditure            4.1298e-04  4.4739e-05   9.2308 < 2.2e-16
## Adult.Mortality                  -2.1591e-02  8.3882e-04 -25.7400 < 2.2e-16
## Alcohol                           9.1950e-02  2.3545e-02   3.9054 9.623e-05
##
## Schooling                        ***
## HIV.AIDS                         ***
## Income.composition.of.resources ***
## BMI                              ***
## Diphtheria                       ***
## Measles                          ***
## percentage.expenditure           ***
## Adult.Mortality                  ***
## Alcohol                          ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    257610
## Residual Sum of Squares: 53648
## R-Squared:      0.79175
## Adj. R-Squared: 0.79002
## F-statistic: 1225.03 on 9 and 2900 DF, p-value: < 2.22e-16
```

Analysis

This model has a high adjusted R^2, but only the time fixed effects have been handled. In next models we'll try to handle the time fixed effects by using the binary regressor for the time periods.

Time Fixed Effects (Binary Regressor)

Model 1 (Binary Regressor for each time period)

In this model, we have a binary variable for each year(time period).

```
## Call:
## lm(formula = Life.expectancy ~ Year + Schooling + HIV.AIDS +
##     Income.composition.of.resources + BMI + Diphtheria + Measles +
##     percentage.expenditure + Adult.Mortality + Alcohol, data = Pooled_Data)
## Residuals:
##      Min       1Q   Median       3Q      Max
## -22.9844  -2.2028   0.0101   2.3898  23.0909
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     5.443e+01  5.367e-01 101.420  < 2e-16 ***
## Year2001                       -5.294e-01  4.509e-01  -1.174  0.24045
## Year2002                       -7.472e-01  4.504e-01  -1.659  0.09727 .
## Year2003                       -7.036e-01  4.511e-01  -1.560  0.11893
## Year2004                       -6.592e-01  4.511e-01  -1.461  0.14410
## Year2005                       -7.711e-01  4.513e-01  -1.709  0.08760 .
## Year2006                       -9.089e-01  4.525e-01  -2.009  0.04467 *
## Year2007                       -1.155e+00  4.531e-01  -2.548  0.01089 *
## Year2008                       -8.208e-01  4.540e-01  -1.808  0.07070 .
## Year2009                       -7.786e-01  4.544e-01  -1.713  0.08674 .
## Year2010                       -7.813e-01  4.539e-01  -1.722  0.08526 .
## Year2011                       -1.070e+00  4.557e-01  -2.347  0.01899 *
## Year2012                       -1.065e+00  4.571e-01  -2.331  0.01982 *
## Year2013                       -1.382e+00  4.525e-01  -3.053  0.00228 **
## Year2014                       -5.912e-01  4.600e-01  -1.285  0.19889
```

```
## Year2015                          -4.562e-01  4.643e-01  -0.983  0.32593
## Schooling                          6.973e-01  4.127e-02  16.896  < 2e-16 ***
## HIV.AIDS                          -4.828e-01  1.858e-02 -25.987  < 2e-16 ***
## Income.composition.of.resources    6.366e+00  6.410e-01   9.932  < 2e-16 ***
## BMI                                5.170e-02  4.841e-03  10.680  < 2e-16 ***
## Diphtheria                         5.990e-02  3.742e-03  16.009  < 2e-16 ***
## Measles                           -3.421e-05  7.105e-06  -4.815 1.55e-06 ***
## percentage.expenditure             4.130e-04  4.474e-05   9.231  < 2e-16 ***
## Adult.Mortality                   -2.159e-02  8.388e-04 -25.740  < 2e-16 ***
## Alcohol                            9.195e-02  2.354e-02   3.905 9.62e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 4.301 on 2900 degrees of freedom
## Multiple R-squared:  0.7973, Adjusted R-squared:  0.7956
## F-statistic: 475.3 on 24 and 2900 DF,  p-value: < 2.2e-16
```

Analysis

This model has a high adjusted R^2, but because of the introduction of several binary variable, a lot of degrees of freedom have been lost. In further models we'll try to handle both the time fixed and entity fixed effects and see if the new models is better able to explain the relationship between the variables.

Entity & Time Fixed Effects

Model 1

In this model, variations across both the time and countries are considered. Through this both the effects that vary across the countries but remain same over time and the effects that vary across the countries and remain same across the countries are handled.

```
## Twoways effects Within Model
## plm(formula = Life.expectancy ~ Schooling + HIV.AIDS + Diphtheria +
##     Measles + Adult.Mortality + Alcohol, data = Pooled_Data,
##     effect = "twoways", model = "within", index = c("Country",
##         "Year"))
```

```
## Unbalanced Panel: n = 193, T = 1-16, N = 2925
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -23.67796  -0.85333  -0.26622   0.49311   9.81653
##
## Coefficients:
##                    Estimate  Std. Error  t-value  Pr(>|t|)
## Schooling        1.5347e-01  3.0397e-02   5.0487 4.743e-07 ***
## HIV.AIDS        -3.3097e-01  1.5021e-02 -22.0336 < 2.2e-16 ***
## Diphtheria       8.2777e-03  2.1006e-03   3.9406 8.332e-05 ***
## Measles         -1.4051e-05  4.3363e-06  -3.2403  0.001208 **
## Adult.Mortality -1.8053e-03  4.5584e-04  -3.9604 7.675e-05 ***
## Alcohol         -5.4393e-02  2.0015e-02  -2.7176  0.006618 **
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Total Sum of Squares:    11922
## Residual Sum of Squares: 9758.8
## R-Squared:      0.18145
## Adj. R-Squared: 0.11713
## F-statistic: 100.156 on 6 and 2711 DF, p-value: < 2.22e-16
bptest(ETF_Modelfinal)
##  studentized Breusch-Pagan test
## data:  ETF_Modelfinal
## BP = 462.23, df = 6, p-value < 2.2e-16
```

Analysis

This model does not have good adjusted R^2.

Random Effect Regression Models

In this the entities are chosen at random, hence the effect of not including the entity would not be correlated with the dependent variable.

```
## Oneway (individual) effect Random Effect Model

##    (Swamy-Arora's transformation)

## plm(formula = Life.expectancy ~ Schooling + HIV.AIDS + Income.composition.of.resources
+

##     BMI + thinness..1.19.years + Diphtheria + Measles + percentage.expenditure +

##     Adult.Mortality, data = Pooled_Data, model = "random", index = c("Country",

##     "Year"))

## Unbalanced Panel: n = 193, T = 1-16, N = 2925

##

## Effects:

##                  var std.dev share

## idiosyncratic 4.588   2.142 0.416

## individual    6.449   2.540 0.584

## theta:

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.

##  0.3553  0.7937  0.7937  0.7917  0.7937  0.7937

## Residuals:

##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.

## -23.0063  -1.2080   0.0792   0.0449   1.0373  12.2079

## Coefficients:

##                                  Estimate  Std. Error  z-value  Pr(>|z|)

## (Intercept)                     5.9507e+01  5.0236e-01 118.4552 < 2.2e-16

## Schooling                       6.4412e-01  3.6188e-02  17.7994 < 2.2e-16

## HIV.AIDS                       -4.5636e-01  1.7597e-02 -25.9335 < 2.2e-16
```

```
## Income.composition.of.resources  2.4650e+00  4.8711e-01   5.0604 4.184e-07
## BMI                               1.5484e-02  3.6188e-03   4.2786 1.881e-05
## thinness..1.19.years             -1.0803e-01  2.3334e-02  -4.6296 3.664e-06
## Diphtheria                        1.9710e-02  2.6039e-03   7.5695 3.746e-14
## Measles                          -2.3947e-05  5.3944e-06  -4.4392 9.030e-06
## percentage.expenditure            1.3908e-04  3.2958e-05   4.2198 2.445e-05
## Adult.Mortality                  -5.0552e-03  5.6662e-04  -8.9217 < 2.2e-16
##
## (Intercept)                      ***
## Schooling                        ***
## HIV.AIDS                         ***
## Income.composition.of.resources ***
## BMI                              ***
## thinness..1.19.years             ***
## Diphtheria                       ***
## Measles                          ***
## percentage.expenditure           ***
## Adult.Mortality                  ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    35789
## Residual Sum of Squares: 16949
## R-Squared:      0.53095
## Adj. R-Squared: 0.52951
## Chisq: 3240.08 on 9 DF, p-value: < 2.22e-16
```

Analysis

Although this model tries to handle the correlation among dependent variable but the adjusted R^2 is not as good as the other models.

First Difference Model:

```
## Oneway (individual) effect First-Difference Model

## plm(formula = Life.expectancy ~ Schooling + HIV.AIDS + +Total.expenditure +

##     Adult.Mortality, data = Pooled_Data, model = "fd", index = c("Country",

##     "Year"))

## Unbalanced Panel: n = 193, T = 1-16, N = 2925

## Observations used in estimation: 2732

##    Min.    1st Qu.     Median    3rd Qu.       Max.

## -25.896840  -0.194116  -0.021581   0.240465  24.699545

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

## (Intercept)        0.2725984  0.0362711  7.5156 7.638e-14 ***

## Schooling          0.0963220  0.0427546  2.2529  0.024345 *

## HIV.AIDS          -0.3103088  0.0555702 -5.5841 2.581e-08 ***

## Total.expenditure -0.0544359  0.0186296 -2.9220  0.003506 **

## Adult.Mortality   -0.0011498  0.0003492 -3.2928  0.001005 **

## Total Sum of Squares:    9286.8

## Residual Sum of Squares: 9103

## R-Squared:      0.019787

## Adj. R-Squared: 0.018349

## F-statistic: 13.7618 on 4 and 2727 DF, p-value: 4.0976e-11
```

Tests

Testing for heteroskedasticity

Breusch-Pagan test for heteroskedasticity

The null hypothesis for the Breusch-Pagan test is homoscedasticity.

data: BinCountry_Model6
BP = 427.26, df = 197, p-value = 2.2e-13

Since, p-value is less than 0.05, we reject the null hypothesis and establish the fact that there is presence of heteroskedasticity in the data.

So, the predicted dependent variables and the residuals of these variables are expected to show heteroskedasticity. To correct this heteroskedasticity-robust standard error can be used.

Testing for serial collinearity

Breusch-Godfrey/ Wooldridge test for serial correlation

The null hypothesis for the Breusch-Godfrey/ Wooldridge test is that there is no serial correlation.

Serial correlation is usually present in panel data spanning over a long time period, which is true in our case (about 26 years).

```
##  Breusch-Godfrey/Wooldridge test for serial correlation in panel

##  models

## data:  Life.expectancy ~ Schooling + HIV.AIDS + Diphtheria + infant.deaths +
Adult.Mortality + Alcohol + Measles + Income.composition.of.resources

## chisq = 689.96, df = 1, p-value < 2.2e-16

## alternative hypothesis: serial correlation in idiosyncratic errors
```

Since, p-value is less than 0.05, we reject the null hypothesis and establish the fact that there is presence of serial correlation in the data.

Testing for Panel Effect

LM Test

To decide whether the OLS Pooled model is better or the Fixed Effects Model, we use the LM Test.

The null hypothesis is that OLS is better than the fixed effects model.

```
##  Lagrange Multiplier Test - (Breusch-Pagan) for unbalanced panels

## data:  Life.expectancy ~ Schooling + Income.composition.of.resources +  ...

## chisq = 7814.9, df = 1, p-value < 2.2e-16
```

```
## alternative hypothesis: significant effects
```

Since p-value is less than 0.05, we reject null hypothesis, thus we can say that the fixed effects model should be chosen over the OLS pooling model.

Hausman Test

Test for choosing between Fixed Effect Model or Random Effect Model

To decide whether the Fixed effect model is better or the Random effect model, we use the Hausman Test.

The null hypothesis is that Fixed Effect model is better than Random Effect model.

```
##  Hausman Test

## data:  Life.expectancy ~ Schooling + HIV.AIDS + Income.composition.of.resources +  ...

## chisq = 1985.8, df = 5, p-value < 2.2e-16

## alternative hypothesis: one model is inconsistent
```

Since the p-value is larger than 0.05, we fail to reject the null hypothesis, thus we can say that fixed effect model is better than the random effects model.

Analysis

Through the above PF Test, we found that fixed entity models will be better able to explain the relationship, so we will be choosing the fixed entity model with the higher adjusted R^2 value.

Also, as per the results of Hausman test, Fixed Effects model is better than the Random effects test. This is understandable because Random effects model presumes that there is no fixed effects & that all variations are caused due to random effects, which clearly is not the case here as each country has its own entity specific effects.

After going through several models, we have found that the Entity Fixed Effects Regression Model with Binary regressor for country is found to be better as it is able to explain the dependable variable much better compared to other models.

Also as mentioned above, the data had heteroskedasticity & serial correlation, so we will be using clustered standard errors & robust standard errors to give more correct values.

Below are the best model result .

```
## lm(formula = Life.expectancy ~ Country + Schooling + HIV.AIDS +

##     Adult.Mortality + Income.composition.of.resources + Alcohol,

##     data = Pooled_Data)

## Residuals:

##      Min       1Q   Median       3Q      Max
```

```
## -22.8099  -0.9721  -0.1509   0.6582  10.9420
##
## Coefficients:
##                                                    Estimate
## (Intercept)                                       5.367e+01
## CountryAlbania                                    1.412e+01
## CountryAlgeria                                    1.210e+01
## CountryAngola                                    -7.609e+00
## CountryAntigua and Barbuda                        1.666e+01
## CountryArgentina                                  1.204e+01
## CountryArmenia                                    1.263e+01
## CountryAustralia                                  1.666e+01
## CountryAustria                                    1.901e+01
## CountryAzerbaijan                                 9.954e+00
## CountryBahamas                                    1.369e+01
## CountryBahrain                                    1.324e+01
## CountryBangladesh                                 1.031e+01
## CountryBarbados                                   1.215e+01
## CountryBelarus                                    8.510e+00
## CountryBelgium                                    1.738e+01
## CountryBelize                                     8.597e+00
## CountryBenin                                     -2.221e-01
## CountryBhutan                                     7.564e+00
## CountryBolivia (Plurinational State of)           6.127e+00
## CountryBosnia and Herzegovina                     1.552e+01
## CountryBotswana                                   3.364e+00
## CountryBrazil                                     1.174e+01
## CountryBrunei Darussalam                          1.384e+01
## CountryBulgaria                                   1.156e+01
## CountryBurkina Faso                               4.148e-01
## CountryBurundi                                   -3.580e-01
## CountryCÃ´te d'Ivoire                            -5.193e+00
```

```
## CountryCabo Verde                                  1.204e+01
## CountryCambodia                                    5.489e+00
## CountryCameroon                                   -1.570e+00
## CountryCanada                                      1.859e+01
## CountryCentral African Republic                   -4.307e+00
## CountryChad                                       -4.667e+00
## CountryChile                                       1.668e+01
## CountryChina                                       1.369e+01
## CountryColombia                                    1.240e+01
## CountryComoros                                     2.741e+00
## CountryCongo                                       2.065e+00
## CountryCook Islands                                2.895e+00
## CountryCosta Rica                                  1.710e+01
## CountryCroatia                                     1.467e+01
## CountryCuba                                        1.551e+01
## CountryCyprus                                      1.805e+01
## CountryCzechia                                     1.640e+01
## CountryDemocratic People's Republic of Korea       8.168e+00
## CountryDemocratic Republic of the Congo           -1.783e+00
## CountryDenmark                                     1.566e+01
## CountryDjibouti                                    5.797e+00
## CountryDominica                                   -1.320e+00
## CountryDominican Republic                          1.194e+01
## CountryEcuador                                     1.341e+01
## CountryEgypt                                       1.065e+01
## CountryEl Salvador                                 1.065e+01
## CountryEquatorial Guinea                          -3.792e-01
## CountryEritrea                                     5.231e+00
## CountryEstonia                                     1.232e+01
## CountryEthiopia                                    3.124e+00
## CountryFiji                                        6.585e+00
## CountryFinland                                     1.708e+01
```

```
## CountryFrance                                    1.953e+01
## CountryGabon                                     5.327e+00
## CountryGambia                                    2.433e+00
## CountryGeorgia                                   1.249e+01
## CountryGermany                                   1.799e+01
## CountryGhana                                     2.602e+00
## CountryGreece                                    1.828e+01
## CountryGrenada                                   1.239e+01
## CountryGuatemala                                 1.226e+01
## CountryGuinea                                   -7.076e-01
## CountryGuinea-Bissau                            -4.424e-01
## CountryGuyana                                    6.521e+00
## CountryHaiti                                     2.829e+00
## CountryHonduras                                  1.330e+01
## CountryHungary                                   1.180e+01
## CountryIceland                                   1.814e+01
## CountryIndia                                     5.972e+00
## CountryIndonesia                                 6.932e+00
## CountryIran (Islamic Republic of)                1.233e+01
## CountryIraq                                      1.051e+01
## CountryIreland                                   1.654e+01
## CountryIsrael                                    1.790e+01
## CountryItaly                                     1.914e+01
## CountryJamaica                                   1.383e+01
## CountryJapan                                     1.982e+01
## CountryJordan                                    1.118e+01
## CountryKazakhstan                                5.274e+00
## CountryKenya                                     2.355e+00
## CountryKiribati                                  5.047e+00
## CountryKuwait                                    1.153e+01
## CountryKyrgyzstan                                8.279e+00
## CountryLao People's Democratic Republic          3.614e+00
```

```
## CountryLatvia                                  1.135e+01
## CountryLebanon                                 1.274e+01
## CountryLesotho                                 1.554e-01
## CountryLiberia                                -2.543e-01
## CountryLibya                                   9.879e+00
## CountryLithuania                               1.030e+01
## CountryLuxembourg                              1.914e+01
## CountryMadagascar                              4.073e+00
## CountryMalawi                                 -1.594e+00
## CountryMalaysia                                1.224e+01
## CountryMaldives                                1.456e+01
## CountryMali                                   -1.571e+00
## CountryMalta                                   1.818e+01
## CountryMarshall Islands                        5.017e+00
## CountryMauritania                              5.166e+00
## CountryMauritius                               1.106e+01
## CountryMexico                                  1.471e+01
## CountryMicronesia (Federated States of)        8.390e+00
## CountryMonaco                                 -2.476e+00
## CountryMongolia                                4.913e+00
## CountryMontenegro                              1.443e+01
## CountryMorocco                                 1.214e+01
## CountryMozambique                              4.199e-01
## CountryMyanmar                                 5.708e+00
## CountryNamibia                                 6.533e+00
## CountryNauru                                  -5.638e-01
## CountryNepal                                   6.714e+00
## CountryNetherlands                             1.750e+01
## CountryNew Zealand                             1.684e+01
## CountryNicaragua                               1.345e+01
## CountryNiger                                   1.653e+00
## CountryNigeria                                -4.368e+00
```

```
## CountryNiue                                  -3.162e+00
## CountryNorway                                 1.766e+01
## CountryOman                                   1.350e+01
## CountryPakistan                               6.648e+00
## CountryPalau                                 -2.611e+00
## CountryPanama                                 1.535e+01
## CountryPapua New Guinea                       3.757e+00
## CountryParaguay                               1.251e+01
## CountryPeru                                   1.229e+01
## CountryPhilippines                            7.392e+00
## CountryPoland                                 1.335e+01
## CountryPortugal                               1.738e+01
## CountryQatar                                  1.515e+01
## CountryRepublic of Korea                      2.167e+01
## CountryRepublic of Moldova                    7.808e+00
## CountryRomania                                1.259e+01
## CountryRussian Federation                     6.799e+00
## CountryRwanda                                 2.912e+00
## CountrySaint Kitts and Nevis                 -2.800e+00
## CountrySaint Lucia                            1.320e+01
## CountrySaint Vincent and the Grenadines       1.249e+01
## CountrySamoa                                  1.248e+01
## CountrySan Marino                            -4.888e+00
## CountrySao Tome and Principe                  6.178e+00
## CountrySaudi Arabia                           1.135e+01
## CountrySenegal                                4.942e+00
## CountrySerbia                                 1.267e+01
## CountrySeychelles                             1.141e+01
## CountrySierra Leone                          -1.082e+01
## CountrySingapore                              1.885e+01
## CountrySlovakia                               1.300e+01
## CountrySlovenia                               1.669e+01
```

```
## CountrySolomon Islands                                          8.902e+00
## CountrySomalia                                                 -7.765e+00
## CountrySouth Africa                                             5.424e+00
## CountrySouth Sudan                                              1.891e+00
## CountrySpain                                                    1.901e+01
## CountrySri Lanka                                                1.182e+01
## CountrySudan                                                    4.667e+00
## CountrySuriname                                                 1.037e+01
## CountrySwaziland                                                6.799e+00
## CountrySweden                                                   1.936e+01
## CountrySwitzerland                                              1.963e+01
## CountrySyrian Arab Republic                                     1.056e+01
## CountryTajikistan                                               6.724e+00
## CountryThailand                                                 1.240e+01
## CountryThe former Yugoslav republic of Macedonia                1.340e+01
## CountryTimor-Leste                                              4.889e+00
## CountryTogo                                                    -9.616e-01
## CountryTonga                                                    1.034e+01
## CountryTrinidad and Tobago                                      1.048e+01
## CountryTunisia                                                  1.203e+01
## CountryTurkey                                                   1.246e+01
## CountryTurkmenistan                                             6.175e+00
## CountryTuvalu                                                   2.136e+00
## CountryUganda                                                   2.508e-01
## CountryUkraine                                                  8.374e+00
## CountryUnited Arab Emirates                                     1.385e+01
## CountryUnited Kingdom of Great Britain and Northern Ireland     1.628e+01
## CountryUnited Republic of Tanzania                             -2.919e+00
## CountryUnited States of America                                 1.767e+01
## CountryUruguay                                                  1.359e+01
## CountryUzbekistan                                               7.614e+00
## CountryVanuatu                                                  1.187e+01
```

```
## CountryVenezuela (Bolivarian Republic of)                  1.244e+01
## CountryViet Nam                                            1.432e+01
## CountryYemen                                               5.252e+00
## CountryZambia                                             -6.241e-01
## CountryZimbabwe                                            2.399e+00
## Schooling                                                  5.112e-01
## HIV.AIDS                                                  -4.396e-01
## Adult.Mortality                                           -2.360e-03
## Income.composition.of.resources                            2.411e+00
## Alcohol                                                   -8.298e-02
##                                                          Std. Error
## (Intercept)                                                6.139e-01
## CountryAlbania                                             7.908e-01
## CountryAlgeria                                             7.815e-01
## CountryAngola                                              7.756e-01
## CountryAntigua and Barbuda                                 7.866e-01
## CountryArgentina                                           8.226e-01
## CountryArmenia                                             7.817e-01
## CountryAustralia                                           8.701e-01
## CountryAustria                                             8.399e-01
## CountryAzerbaijan                                          7.777e-01
## CountryBahamas                                             8.076e-01
## CountryBahrain                                             7.941e-01
## CountryBangladesh                                          7.691e-01
## CountryBarbados                                            8.132e-01
## CountryBelarus                                             8.364e-01
## CountryBelgium                                             8.425e-01
## CountryBelize                                              7.889e-01
## CountryBenin                                               7.664e-01
## CountryBhutan                                              7.809e-01
## CountryBolivia (Plurinational State of)                    7.881e-01
## CountryBosnia and Herzegovina                              7.892e-01
```

```
## CountryBotswana                                    8.295e-01
## CountryBrazil                                      8.020e-01
## CountryBrunei Darussalam                           7.944e-01
## CountryBulgaria                                    8.194e-01
## CountryBurkina Faso                                7.767e-01
## CountryBurundi                                     7.726e-01
## CountryCÃ´te d'Ivoire                              7.739e-01
## CountryCabo Verde                                  7.818e-01
## CountryCambodia                                    7.689e-01
## CountryCameroon                                    7.769e-01
## CountryCanada                                      8.236e-01
## CountryCentral African Republic                    7.802e-01
## CountryChad                                        7.714e-01
## CountryChile                                       8.229e-01
## CountryChina                                       7.832e-01
## CountryColombia                                    7.838e-01
## CountryComoros                                     7.708e-01
## CountryCongo                                       7.735e-01
## CountryCook Islands                                2.239e+00
## CountryCosta Rica                                  7.892e-01
## CountryCroatia                                     8.303e-01
## CountryCuba                                        7.998e-01
## CountryCyprus                                      8.198e-01
## CountryCzechia                                     8.266e-01
## CountryDemocratic People's Republic of Korea       7.930e-01
## CountryDemocratic Republic of the Congo            7.669e-01
## CountryDenmark                                     8.447e-01
## CountryDjibouti                                    7.763e-01
## CountryDominica                                    2.236e+00
## CountryDominican Republic                          7.902e-01
## CountryEcuador                                     7.855e-01
## CountryEgypt                                       7.751e-01
```

```
## CountryEl Salvador                                  7.930e-01
## CountryEquatorial Guinea                            7.873e-01
## CountryEritrea                                      7.720e-01
## CountryEstonia                                      8.234e-01
## CountryEthiopia                                     7.681e-01
## CountryFiji                                         7.891e-01
## CountryFinland                                      8.412e-01
## CountryFrance                                       8.466e-01
## CountryGabon                                        8.055e-01
## CountryGambia                                       7.679e-01
## CountryGeorgia                                      7.897e-01
## CountryGermany                                      8.461e-01
## CountryGhana                                        7.698e-01
## CountryGreece                                       8.249e-01
## CountryGrenada                                      8.424e-01
## CountryGuatemala                                    7.727e-01
## CountryGuinea                                       7.796e-01
## CountryGuinea-Bissau                                7.777e-01
## CountryGuyana                                       7.880e-01
## CountryHaiti                                        7.785e-01
## CountryHonduras                                     7.760e-01
## CountryHungary                                      8.313e-01
## CountryIceland                                      8.413e-01
## CountryIndia                                        7.717e-01
## CountryIndonesia                                    7.744e-01
## CountryIran (Islamic Republic of)                   7.819e-01
## CountryIraq                                         7.725e-01
## CountryIreland                                      8.621e-01
## CountryIsrael                                       8.070e-01
## CountryItaly                                        8.373e-01
## CountryJamaica                                      7.839e-01
## CountryJapan                                        8.133e-01
```

```
## CountryJordan                                    7.844e-01
## CountryKazakhstan                                7.987e-01
## CountryKenya                                     7.820e-01
## CountryKiribati                                  7.806e-01
## CountryKuwait                                    7.898e-01
## CountryKyrgyzstan                                7.783e-01
## CountryLao People's Democratic Republic          7.717e-01
## CountryLatvia                                    8.198e-01
## CountryLebanon                                   7.941e-01
## CountryLesotho                                   8.626e-01
## CountryLiberia                                   7.729e-01
## CountryLibya                                     7.920e-01
## CountryLithuania                                 8.466e-01
## CountryLuxembourg                                8.473e-01
## CountryMadagascar                                7.669e-01
## CountryMalawi                                    8.176e-01
## CountryMalaysia                                  7.822e-01
## CountryMaldives                                  7.798e-01
## CountryMali                                      7.689e-01
## CountryMalta                                     8.086e-01
## CountryMarshall Islands                          2.267e+00
## CountryMauritania                                7.695e-01
## CountryMauritius                                 7.860e-01
## CountryMexico                                    7.885e-01
## CountryMicronesia (Federated States of)          7.724e-01
## CountryMonaco                                    2.239e+00
## CountryMongolia                                  7.790e-01
## CountryMontenegro                                7.766e-01
## CountryMorocco                                   7.736e-01
## CountryMozambique                                7.891e-01
## CountryMyanmar                                   7.684e-01
## CountryNamibia                                   8.257e-01
```

```
## CountryNauru                                  2.236e+00
## CountryNepal                                  7.705e-01
## CountryNetherlands                            8.377e-01
## CountryNew Zealand                            8.549e-01
## CountryNicaragua                              7.772e-01
## CountryNiger                                  7.764e-01
## CountryNigeria                                7.931e-01
## CountryNiue                                   2.239e+00
## CountryNorway                                 8.302e-01
## CountryOman                                   7.830e-01
## CountryPakistan                               7.720e-01
## CountryPalau                                  2.251e+00
## CountryPanama                                 7.954e-01
## CountryPapua New Guinea                       7.663e-01
## CountryParaguay                               7.875e-01
## CountryPeru                                   7.899e-01
## CountryPhilippines                            7.802e-01
## CountryPoland                                 8.264e-01
## CountryPortugal                               8.587e-01
## CountryQatar                                  7.895e-01
## CountryRepublic of Korea                      7.940e-01
## CountryRepublic of Moldova                    8.238e-01
## CountryRomania                                8.113e-01
## CountryRussian Federation                     8.213e-01
## CountryRwanda                                 7.804e-01
## CountrySaint Kitts and Nevis                  2.245e+00
## CountrySaint Lucia                            8.190e-01
## CountrySaint Vincent and the Grenadines       7.936e-01
## CountrySamoa                                  7.829e-01
## CountrySan Marino                             2.241e+00
## CountrySao Tome and Principe                  7.766e-01
## CountrySaudi Arabia                           7.897e-01
```

```
## CountrySenegal                                          7.687e-01
## CountrySerbia                                           8.086e-01
## CountrySeychelles                                       7.929e-01
## CountrySierra Leone                                     7.713e-01
## CountrySingapore                                        8.077e-01
## CountrySlovakia                                         8.243e-01
## CountrySlovenia                                         8.428e-01
## CountrySolomon Islands                                  7.687e-01
## CountrySomalia                                          7.960e-01
## CountrySouth Africa                                     8.501e-01
## CountrySouth Sudan                                      8.034e-01
## CountrySpain                                            8.370e-01
## CountrySri Lanka                                        7.846e-01
## CountrySudan                                            7.701e-01
## CountrySuriname                                         7.838e-01
## CountrySwaziland                                        9.435e-01
## CountrySweden                                           8.212e-01
## CountrySwitzerland                                      8.356e-01
## CountrySyrian Arab Republic                             7.737e-01
## CountryTajikistan                                       7.709e-01
## CountryThailand                                         7.911e-01
## CountryThe former Yugoslav republic of Macedonia        7.860e-01
## CountryTimor-Leste                                      7.706e-01
## CountryTogo                                             7.732e-01
## CountryTonga                                            7.885e-01
## CountryTrinidad and Tobago                              8.028e-01
## CountryTunisia                                          7.942e-01
## CountryTurkey                                           7.826e-01
## CountryTurkmenistan                                     7.790e-01
## CountryTuvalu                                           2.277e+00
## CountryUganda                                           7.958e-01
## CountryUkraine                                          8.033e-01
```

```
## CountryUnited Arab Emirates                                      7.895e-01
## CountryUnited Kingdom of Great Britain and Northern Ireland  8.693e-01
## CountryUnited Republic of Tanzania                               8.053e-01
## CountryUnited States of America                                  8.019e-01
## CountryUruguay                                                   8.060e-01
## CountryUzbekistan                                                7.740e-01
## CountryVanuatu                                                   7.744e-01
## CountryVenezuela (Bolivarian Republic of)                        7.953e-01
## CountryViet Nam                                                  7.779e-01
## CountryYemen                                                     7.663e-01
## CountryZambia                                                    8.118e-01
## CountryZimbabwe                                                  8.601e-01
## Schooling                                                        3.506e-02
## HIV.AIDS                                                         1.657e-02
## Adult.Mortality                                                  5.171e-04
## Income.composition.of.resources                                  4.463e-01
## Alcohol                                                          2.204e-02
##                                                                 t value
## (Intercept)                                                      87.426
## CountryAlbania                                                   17.854
## CountryAlgeria                                                   15.485
## CountryAngola                                                    -9.811
## CountryAntigua and Barbuda                                       21.176
## CountryArgentina                                                 14.640
## CountryArmenia                                                   16.151
## CountryAustralia                                                 19.153
## CountryAustria                                                   22.636
## CountryAzerbaijan                                                12.799
## CountryBahamas                                                   16.954
## CountryBahrain                                                   16.671
## CountryBangladesh                                                13.407
## CountryBarbados                                                  14.936
```

```
## CountryBelarus                                    10.175
## CountryBelgium                                    20.626
## CountryBelize                                     10.897
## CountryBenin                                      -0.290
## CountryBhutan                                      9.685
## CountryBolivia (Plurinational State of)            7.775
## CountryBosnia and Herzegovina                     19.671
## CountryBotswana                                    4.055
## CountryBrazil                                     14.643
## CountryBrunei Darussalam                          17.420
## CountryBulgaria                                   14.102
## CountryBurkina Faso                                0.534
## CountryBurundi                                    -0.463
## CountryCÃ´te d'Ivoire                             -6.709
## CountryCabo Verde                                 15.396
## CountryCambodia                                    7.138
## CountryCameroon                                   -2.021
## CountryCanada                                     22.572
## CountryCentral African Republic                   -5.520
## CountryChad                                       -6.050
## CountryChile                                      20.272
## CountryChina                                      17.483
## CountryColombia                                   15.820
## CountryComoros                                     3.556
## CountryCongo                                       2.670
## CountryCook Islands                                1.293
## CountryCosta Rica                                 21.661
## CountryCroatia                                    17.666
## CountryCuba                                       19.389
## CountryCyprus                                     22.022
## CountryCzechia                                    19.845
## CountryDemocratic People's Republic of Korea      10.300
```

```
## CountryDemocratic Republic of the Congo                    -2.325
## CountryDenmark                                             18.536
## CountryDjibouti                                             7.467
## CountryDominica                                            -0.591
## CountryDominican Republic                                  15.106
## CountryEcuador                                             17.070
## CountryEgypt                                               13.735
## CountryEl Salvador                                         13.433
## CountryEquatorial Guinea                                   -0.482
## CountryEritrea                                              6.776
## CountryEstonia                                             14.968
## CountryEthiopia                                             4.067
## CountryFiji                                                 8.345
## CountryFinland                                             20.303
## CountryFrance                                              23.072
## CountryGabon                                                6.613
## CountryGambia                                               3.169
## CountryGeorgia                                             15.816
## CountryGermany                                             21.265
## CountryGhana                                                3.379
## CountryGreece                                              22.162
## CountryGrenada                                             14.705
## CountryGuatemala                                           15.864
## CountryGuinea                                              -0.908
## CountryGuinea-Bissau                                       -0.569
## CountryGuyana                                               8.275
## CountryHaiti                                                3.634
## CountryHonduras                                            17.143
## CountryHungary                                             14.199
## CountryIceland                                             21.558
## CountryIndia                                                7.738
## CountryIndonesia                                            8.952
```

```
## CountryIran (Islamic Republic of)                    15.768
## CountryIraq                                          13.599
## CountryIreland                                       19.183
## CountryIsrael                                        22.187
## CountryItaly                                         22.860
## CountryJamaica                                       17.644
## CountryJapan                                         24.372
## CountryJordan                                        14.258
## CountryKazakhstan                                     6.603
## CountryKenya                                          3.012
## CountryKiribati                                       6.466
## CountryKuwait                                        14.605
## CountryKyrgyzstan                                    10.637
## CountryLao People's Democratic Republic               4.684
## CountryLatvia                                        13.840
## CountryLebanon                                       16.050
## CountryLesotho                                        0.180
## CountryLiberia                                       -0.329
## CountryLibya                                         12.473
## CountryLithuania                                     12.168
## CountryLuxembourg                                    22.591
## CountryMadagascar                                     5.311
## CountryMalawi                                        -1.950
## CountryMalaysia                                      15.644
## CountryMaldives                                      18.669
## CountryMali                                          -2.044
## CountryMalta                                         22.486
## CountryMarshall Islands                               2.213
## CountryMauritania                                     6.714
## CountryMauritius                                     14.068
## CountryMexico                                        18.656
## CountryMicronesia (Federated States of)              10.861
```

```
## CountryMonaco                                  -1.106
## CountryMongolia                                 6.307
## CountryMontenegro                              18.582
## CountryMorocco                                 15.688
## CountryMozambique                               0.532
## CountryMyanmar                                  7.428
## CountryNamibia                                  7.912
## CountryNauru                                   -0.252
## CountryNepal                                    8.713
## CountryNetherlands                             20.887
## CountryNew Zealand                             19.701
## CountryNicaragua                               17.310
## CountryNiger                                    2.128
## CountryNigeria                                 -5.508
## CountryNiue                                    -1.413
## CountryNorway                                  21.274
## CountryOman                                    17.236
## CountryPakistan                                 8.611
## CountryPalau                                   -1.160
## CountryPanama                                  19.293
## CountryPapua New Guinea                         4.903
## CountryParaguay                                15.886
## CountryPeru                                    15.562
## CountryPhilippines                              9.475
## CountryPoland                                  16.149
## CountryPortugal                                20.240
## CountryQatar                                   19.190
## CountryRepublic of Korea                       27.293
## CountryRepublic of Moldova                      9.477
## CountryRomania                                 15.518
## CountryRussian Federation                       8.279
## CountryRwanda                                   3.731
```

```
## CountrySaint Kitts and Nevis                                -1.247
## CountrySaint Lucia                                          16.113
## CountrySaint Vincent and the Grenadines                     15.745
## CountrySamoa                                                15.938
## CountrySan Marino                                           -2.181
## CountrySao Tome and Principe                                 7.955
## CountrySaudi Arabia                                         14.375
## CountrySenegal                                               6.430
## CountrySerbia                                               15.666
## CountrySeychelles                                           14.386
## CountrySierra Leone                                        -14.027
## CountrySingapore                                            23.337
## CountrySlovakia                                             15.777
## CountrySlovenia                                             19.803
## CountrySolomon Islands                                      11.580
## CountrySomalia                                              -9.754
## CountrySouth Africa                                          6.380
## CountrySouth Sudan                                           2.353
## CountrySpain                                                22.707
## CountrySri Lanka                                            15.061
## CountrySudan                                                 6.060
## CountrySuriname                                             13.224
## CountrySwaziland                                             7.206
## CountrySweden                                               23.571
## CountrySwitzerland                                          23.489
## CountrySyrian Arab Republic                                 13.652
## CountryTajikistan                                            8.723
## CountryThailand                                             15.671
## CountryThe former Yugoslav republic of Macedonia            17.047
## CountryTimor-Leste                                           6.344
## CountryTogo                                                 -1.244
## CountryTonga                                                13.119
```

```
## CountryTrinidad and Tobago                                    13.051
## CountryTunisia                                                15.142
## CountryTurkey                                                 15.920
## CountryTurkmenistan                                            7.927
## CountryTuvalu                                                  0.938
## CountryUganda                                                  0.315
## CountryUkraine                                                10.425
## CountryUnited Arab Emirates                                   17.541
## CountryUnited Kingdom of Great Britain and Northern Ireland   18.730
## CountryUnited Republic of Tanzania                            -3.624
## CountryUnited States of America                               22.036
## CountryUruguay                                                16.856
## CountryUzbekistan                                              9.837
## CountryVanuatu                                                15.326
## CountryVenezuela (Bolivarian Republic of)                     15.641
## CountryViet Nam                                               18.403
## CountryYemen                                                   6.854
## CountryZambia                                                 -0.769
## CountryZimbabwe                                                2.789
## Schooling                                                     14.580
## HIV.AIDS                                                     -26.529
## Adult.Mortality                                               -4.564
## Income.composition.of.resources                                5.403
## Alcohol                                                       -3.765
##                                                              Pr(>|t|)
## (Intercept)                                                   < 2e-16 ***
## CountryAlbania                                                < 2e-16 ***
## CountryAlgeria                                                < 2e-16 ***
## CountryAngola                                                 < 2e-16 ***
## CountryAntigua and Barbuda                                    < 2e-16 ***
## CountryArgentina                                              < 2e-16 ***
## CountryArmenia                                                < 2e-16 ***
```

```
## CountryAustralia                                  < 2e-16 ***
## CountryAustria                                    < 2e-16 ***
## CountryAzerbaijan                                 < 2e-16 ***
## CountryBahamas                                    < 2e-16 ***
## CountryBahrain                                    < 2e-16 ***
## CountryBangladesh                                 < 2e-16 ***
## CountryBarbados                                   < 2e-16 ***
## CountryBelarus                                    < 2e-16 ***
## CountryBelgium                                    < 2e-16 ***
## CountryBelize                                     < 2e-16 ***
## CountryBenin                                     0.772029
## CountryBhutan                                     < 2e-16 ***
## CountryBolivia (Plurinational State of)          1.06e-14 ***
## CountryBosnia and Herzegovina                     < 2e-16 ***
## CountryBotswana                                  5.15e-05 ***
## CountryBrazil                                     < 2e-16 ***
## CountryBrunei Darussalam                          < 2e-16 ***
## CountryBulgaria                                   < 2e-16 ***
## CountryBurkina Faso                              0.593288
## CountryBurundi                                   0.643077
## CountryCÃ´te d'Ivoire                            2.37e-11 ***
## CountryCabo Verde                                 < 2e-16 ***
## CountryCambodia                                  1.21e-12 ***
## CountryCameroon                                  0.043399 *
## CountryCanada                                     < 2e-16 ***
## CountryCentral African Republic                  3.70e-08 ***
## CountryChad                                      1.65e-09 ***
## CountryChile                                      < 2e-16 ***
## CountryChina                                      < 2e-16 ***
## CountryColombia                                   < 2e-16 ***
## CountryComoros                                   0.000383 ***
## CountryCongo                                     0.007626 **
```

```
## CountryCook Islands                                  0.196098
## CountryCosta Rica                                     < 2e-16 ***
## CountryCroatia                                        < 2e-16 ***
## CountryCuba                                           < 2e-16 ***
## CountryCyprus                                         < 2e-16 ***
## CountryCzechia                                        < 2e-16 ***
## CountryDemocratic People's Republic of Korea          < 2e-16 ***
## CountryDemocratic Republic of the Congo               0.020158 *
## CountryDenmark                                        < 2e-16 ***
## CountryDjibouti                                       1.10e-13 ***
## CountryDominica                                       0.554895
## CountryDominican Republic                             < 2e-16 ***
## CountryEcuador                                        < 2e-16 ***
## CountryEgypt                                          < 2e-16 ***
## CountryEl Salvador                                    < 2e-16 ***
## CountryEquatorial Guinea                              0.630104
## CountryEritrea                                        1.50e-11 ***
## CountryEstonia                                        < 2e-16 ***
## CountryEthiopia                                       4.90e-05 ***
## CountryFiji                                           < 2e-16 ***
## CountryFinland                                        < 2e-16 ***
## CountryFrance                                         < 2e-16 ***
## CountryGabon                                          4.50e-11 ***
## CountryGambia                                         0.001548 **
## CountryGeorgia                                        < 2e-16 ***
## CountryGermany                                        < 2e-16 ***
## CountryGhana                                          0.000737 ***
## CountryGreece                                         < 2e-16 ***
## CountryGrenada                                        < 2e-16 ***
## CountryGuatemala                                      < 2e-16 ***
## CountryGuinea                                         0.364116
## CountryGuinea-Bissau                                  0.569446
```

```
## CountryGuyana                                    < 2e-16 ***
## CountryHaiti                                    0.000285 ***
## CountryHonduras                                  < 2e-16 ***
## CountryHungary                                   < 2e-16 ***
## CountryIceland                                   < 2e-16 ***
## CountryIndia                                    1.41e-14 ***
## CountryIndonesia                                 < 2e-16 ***
## CountryIran (Islamic Republic of)                < 2e-16 ***
## CountryIraq                                      < 2e-16 ***
## CountryIreland                                   < 2e-16 ***
## CountryIsrael                                    < 2e-16 ***
## CountryItaly                                     < 2e-16 ***
## CountryJamaica                                   < 2e-16 ***
## CountryJapan                                     < 2e-16 ***
## CountryJordan                                    < 2e-16 ***
## CountryKazakhstan                               4.83e-11 ***
## CountryKenya                                    0.002622 **
## CountryKiribati                                 1.19e-10 ***
## CountryKuwait                                    < 2e-16 ***
## CountryKyrgyzstan                                < 2e-16 ***
## CountryLao People's Democratic Republic         2.96e-06 ***
## CountryLatvia                                    < 2e-16 ***
## CountryLebanon                                   < 2e-16 ***
## CountryLesotho                                  0.857082
## CountryLiberia                                  0.742134
## CountryLibya                                     < 2e-16 ***
## CountryLithuania                                 < 2e-16 ***
## CountryLuxembourg                                < 2e-16 ***
## CountryMadagascar                               1.18e-07 ***
## CountryMalawi                                   0.051332 .
## CountryMalaysia                                  < 2e-16 ***
## CountryMaldives                                  < 2e-16 ***
```

```
## CountryMali                                          0.041087 *
## CountryMalta                                          < 2e-16 ***
## CountryMarshall Islands                              0.026967 *
## CountryMauritania                                    2.30e-11 ***
## CountryMauritius                                      < 2e-16 ***
## CountryMexico                                         < 2e-16 ***
## CountryMicronesia (Federated States of)               < 2e-16 ***
## CountryMonaco                                        0.268766
## CountryMongolia                                      3.31e-10 ***
## CountryMontenegro                                     < 2e-16 ***
## CountryMorocco                                        < 2e-16 ***
## CountryMozambique                                    0.594668
## CountryMyanmar                                       1.46e-13 ***
## CountryNamibia                                       3.66e-15 ***
## CountryNauru                                         0.800955
## CountryNepal                                          < 2e-16 ***
## CountryNetherlands                                    < 2e-16 ***
## CountryNew Zealand                                    < 2e-16 ***
## CountryNicaragua                                      < 2e-16 ***
## CountryNiger                                         0.033393 *
## CountryNigeria                                       3.98e-08 ***
## CountryNiue                                          0.157914
## CountryNorway                                         < 2e-16 ***
## CountryOman                                           < 2e-16 ***
## CountryPakistan                                       < 2e-16 ***
## CountryPalau                                         0.246137
## CountryPanama                                         < 2e-16 ***
## CountryPapua New Guinea                              9.99e-07 ***
## CountryParaguay                                       < 2e-16 ***
## CountryPeru                                           < 2e-16 ***
## CountryPhilippines                                    < 2e-16 ***
## CountryPoland                                         < 2e-16 ***
```

```
## CountryPortugal                                    < 2e-16 ***
## CountryQatar                                       < 2e-16 ***
## CountryRepublic of Korea                           < 2e-16 ***
## CountryRepublic of Moldova                         < 2e-16 ***
## CountryRomania                                     < 2e-16 ***
## CountryRussian Federation                          < 2e-16 ***
## CountryRwanda                                     0.000194 ***
## CountrySaint Kitts and Nevis                      0.212391
## CountrySaint Lucia                                 < 2e-16 ***
## CountrySaint Vincent and the Grenadines            < 2e-16 ***
## CountrySamoa                                       < 2e-16 ***
## CountrySan Marino                                 0.029244 *
## CountrySao Tome and Principe                      2.61e-15 ***
## CountrySaudi Arabia                                < 2e-16 ***
## CountrySenegal                                    1.50e-10 ***
## CountrySerbia                                      < 2e-16 ***
## CountrySeychelles                                  < 2e-16 ***
## CountrySierra Leone                                < 2e-16 ***
## CountrySingapore                                   < 2e-16 ***
## CountrySlovakia                                    < 2e-16 ***
## CountrySlovenia                                    < 2e-16 ***
## CountrySolomon Islands                             < 2e-16 ***
## CountrySomalia                                     < 2e-16 ***
## CountrySouth Africa                               2.08e-10 ***
## CountrySouth Sudan                                0.018669 *
## CountrySpain                                       < 2e-16 ***
## CountrySri Lanka                                   < 2e-16 ***
## CountrySudan                                      1.55e-09 ***
## CountrySuriname                                    < 2e-16 ***
## CountrySwaziland                                  7.40e-13 ***
## CountrySweden                                      < 2e-16 ***
## CountrySwitzerland                                 < 2e-16 ***
```

```
## CountrySyrian Arab Republic                                  < 2e-16 ***
## CountryTajikistan                                            < 2e-16 ***
## CountryThailand                                              < 2e-16 ***
## CountryThe former Yugoslav republic of Macedonia             < 2e-16 ***
## CountryTimor-Leste                                          2.60e-10 ***
## CountryTogo                                                 0.213684
## CountryTonga                                                 < 2e-16 ***
## CountryTrinidad and Tobago                                   < 2e-16 ***
## CountryTunisia                                               < 2e-16 ***
## CountryTurkey                                                < 2e-16 ***
## CountryTurkmenistan                                         3.25e-15 ***
## CountryTuvalu                                               0.348196
## CountryUganda                                               0.752714
## CountryUkraine                                               < 2e-16 ***
## CountryUnited Arab Emirates                                  < 2e-16 ***
## CountryUnited Kingdom of Great Britain and Northern Ireland  < 2e-16 ***
## CountryUnited Republic of Tanzania                          0.000295 ***
## CountryUnited States of America                              < 2e-16 ***
## CountryUruguay                                               < 2e-16 ***
## CountryUzbekistan                                            < 2e-16 ***
## CountryVanuatu                                               < 2e-16 ***
## CountryVenezuela (Bolivarian Republic of)                    < 2e-16 ***
## CountryViet Nam                                              < 2e-16 ***
## CountryYemen                                                8.84e-12 ***
## CountryZambia                                               0.442106
## CountryZimbabwe                                             0.005324 **
## Schooling                                                    < 2e-16 ***
## HIV.AIDS                                                     < 2e-16 ***
## Adult.Mortality                                             5.25e-06 ***
## Income.composition.of.resources                             7.12e-08 ***
## Alcohol                                                     0.000170 ***
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Residual standard error: 2.165 on 2727 degrees of freedom
## Multiple R-squared:  0.9517, Adjusted R-squared:  0.9482
## F-statistic: 272.8 on 197 and 2727 DF,  p-value: < 2.2e-16
```

Conclusion

After making several models and carrying out various tests, we have found that Fixed Effects Regression model is better than Pooled OLS or Random Effect Model, and that the Entity Fixed Effect model with Binary regressor has a higher adjusted R^2 value and is better able to explain the dependable variable.

Also, the heterogeneity graphs over individual and over years suggest that the data has heterogeneity.Binary regressor with countries is our best model .Coefficients are shown in previous page.Table is large because of 195 counries.

Even after all these regressions, we can't guarantee that the models in here will be able to perfectly capture the relation of the dependable variable as there might be omitted variable bias.

R Code

```
data<-read.csv("datasets_12603_17232_Life Expectancy Data.csv")

colSums(is.na(data))

data1<-data[-c(0:3)]

library(ggplot2)

library(GGally)

library(corrplot)

ggcorr(data1, nbreaks = 4, palette = "RdGy", label = TRUE, label_size = 3, label_color ="white")

library(dplyr)

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Adult.Mortality))

data$Adult.Mortality[is.na(data$Adult.Mortality)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Life.expectancy))

data$Life.expectancy[is.na(data$Life.expectancy)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Polio))

data$Polio[is.na(data$Polio)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Diphtheria))

data$Diphtheria[is.na(data$Diphtheria)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(thinness..1.19.years))

data$thinness..1.19.years[is.na(data$thinness..1.19.years)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Schooling))

data$Schooling[is.na(data$Schooling)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(BMI ))

data$BMI [is.na(data$BMI )] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(thinness.5.9.years))
```

```
data$thinness.5.9.years[is.na(data$thinness.5.9.years)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Alcohol))

data$Alcohol[is.na(data$Alcohol)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(avg))

data$avg[is.na(data$avg)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Total.expenditure))

data$Total.expenditure[is.na(data$Total.expenditure)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg =
mean(Income.composition.of.resources))

data$Income.composition.of.resources[is.na(data$Income.composition.of.resources)] <- data$avg

data<- data %>% group_by(Country,Year) %>% mutate(avg = mean(Alcohol))

data$Alcohol[is.na(data$Alcohol)] <- data$avg

colSums(is.na(data))

data$Year<-as.factor(data$Year)


data<-select(data,-c(Hepatitis.B,under.five.deaths,GDP,Polio,Population, thinness.5.9.years,avg))

datafinal<-na.omit(data)

summary(datafinal)

ggplot(data = datafinal,aes(y=Life.expectancy,x=Adult.Mortality))+geom_point()

ggplot(data = datafinal,aes(y=Life.expectancy,x=Adult.Mortality,col=Status))+geom_point()

ggplot(data = datafinal,aes(y=Life.expectancy,x=infant.deaths))+geom_point()

ggplot(data = datafinal,aes(y=Life.expectancy,x=Alcohol,col=Status))+geom_point()

ggplot(data = datafinal,aes(y=Life.expectancy,x=HIV.AIDS,col=Status))+geom_point()

HISTOGRAM

ggplot(data = datafinal,aes(x=Life.expectancy))+geom_histogram(bins = 50,fill="palegreen4")
```

```
ggplot(data = datafinal,aes(x=Life.expectancy,fill=Status))+geom_histogram(bins = 50,position = "fill")

ggplot(data = datafinal,aes(x=Schooling,fill=Status))+geom_histogram(bins = 50,position = "fill")

ggplot(data = datafinal,aes(x=HIV.AIDS,fill=Status))+geom_histogram(bins = 50,position = "fill")

ggplot(data = datafinal,aes(x=BMI,fill=Status))+geom_histogram(bins = 50,position = "fill")

ggplot(data=datafinal,aes(x=Life.expectancy,col=Year))+geom_freqpoly(bins=30)

ggplot(data=datafinal,aes(x=Life.expectancy,col=Status))+geom_freqpoly(bins=30)

ggplot(data=datafinal,aes(x=factor(Year),y=Life.expectancy))+geom_boxplot()

ggplot(data=datafinal,aes(x=factor(Year),y=Life.expectancy,fill=Status))+geom_boxplot()

library(olsrr)

library(gvlma)

library(car)

library(gplots)

library(plm)

library(sandwich)

library(lmtest)

ggplot(data= datafinal, aes(x=Country, y=Life.expectancy, group = Year, colour = Year))+

geom_point() +

geom_smooth(method =lm, se= TRUE) +

labs(x= "Country", y= "Life.expectancy", title = "Life.expectancy Versus Country")

plotmeans(Life.expectancy~Year, error.bars="sd", main="Deviations-Years", data=datafinal,xlab="year",ylab="Life.expectancy")

plotmeans(Life.expectancy ~ Country, main="Deviations-Country", data=data, xlab="Country", ylab= "Life.expectancy" )
```

MODELS

#POOLING MODELS

#model1

```
Pooled_Data<-pdata.frame(datafinal,index=c("Country","Year"))

Pooled_model1 <- plm(Life.expectancy~ Schooling,data=Pooled_Data, model = 'pooling')

summary(Pooled_model1)
```

#model2

```
Pooled_model2 <- plm(Life.expectancy~
Schooling+Income.composition.of.resources,data=Pooled_Data, model = 'pooling')

summary(Pooled_model2)
```

#model3

```
Pooled_model3 <- plm(Life.expectancy~
Schooling+Income.composition.of.resources+BMI,data=Pooled_Data, model = 'pooling')

summary(Pooled_model3)
```

#model4

```
Pooled_model4 <- plm(Life.expectancy~
Schooling+Income.composition.of.resources+BMI+Alcohol,data=Pooled_Data, model = 'pooling')

summary(Pooled_model4)
```

#model5

```
Pooled_model5 <- plm(Life.expectancy~
Schooling+Income.composition.of.resources+BMI+Alcohol+percentage.expenditure,data=Pooled
_Data, model = 'pooling')

summary(Pooled_model5)
```

#model6

```
Pooled_model6 <- plm(Life.expectancy~
Schooling+Income.composition.of.resources+BMI+Alcohol+percentage.expenditure+HIV.AIDS,
data=Pooled_Data, model = 'pooling')
```

```
summary(Pooled_model6)

#model7

Pooled_model7 <- plm(Life.expectancy~
Schooling+Income.composition.of.resources+BMI+Alcohol+percentage.expenditure+HIV.AIDS+
thinness..1.19.years,data=Pooled_Data, model = 'pooling')

summary(Pooled_model7)

#model8

Pooled_model8<-
plm(Life.expectancy~Schooling+Income.composition.of.resources+BMI+percentage.expenditure
+HIV.AIDS+thinness..1.19.years+Diphtheria+Total.expenditure,data=Pooled_Data, model =
'pooling')

summary(Pooled_model8)

#final pooled model(selected)

Pooled_modelfinal <-
plm(Life.expectancy~Schooling+Income.composition.of.resources+BMI+percentage.expenditure
+HIV.AIDS+thinness..1.19.years+Diphtheria,data=Pooled_Data, model = 'pooling')

summary(Pooled_modelfinal)

Entity Demeaned Models

#model1

EF_Model1 <- plm(Life.expectancy~ Schooling,data=Pooled_Data, model = 'within', effect =
'individual')

summary(EF_Model1)

#model2

EF_Model2 <- plm(Life.expectancy~ Schooling+HIV.AIDS,data=Pooled_Data, model = 'within',
effect = 'individual')

summary(EF_Model2)

#MODEL3

EF_Model4 <- plm(Life.expectancy~ Schooling+HIV.AIDS+BMI,data=Pooled_Data, model =
'within', effect = 'individual')
```

```
summary(EF_Model4)

#model4

EF_Model5 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure,data=Pooled_Data, model = 'within', effect =
'individual')

summary(EF_Model5)

#model5

EF_Model6 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria,data=Pooled_Data, model = 'within',
effect = 'individual')

summary(EF_Model6)

#model6

EF_Model7 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Diphtheria+Total.expenditure+thinness..1.19.years,data=Pooled_Dat
a, model = 'within', effect = 'individual')

summary(EF_Model7)

#model7

EF_Model8 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria+thinness..1.19.years+percentage.expe
nditure,data=Pooled_Data, model = 'within', effect = 'individual')

summary(EF_Model8)

#model8

EF_Model9 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria+thinness..1.19.years+percentage.expe
nditure+infant.deaths,data=Pooled_Data, model = 'within', effect = 'individual')

summary(EF_Model9)

#model9

EF_Model8 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria+thinness..1.19.years+percentage.expe
nditure+infant.deaths+Adult.Mortality,data=Pooled_Data, model = 'within', effect = 'individual')
```

```
summary(EF_Model8)

#model10

EF_Model11<- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria+thinness..1.19.years+percentage.expe
nditure+infant.deaths+Adult.Mortality+Alcohol,data=Pooled_Data, model = 'within', effect =
'individual')

summary(EF_Model11)

#model11

EF_Model12 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria+thinness..1.19.years+percentage.expe
nditure+i

nfant.deaths+Adult.Mortality+Alcohol+Measles,data=Pooled_Data, model = 'within', effect =
'individual')

summary(EF_Model12)

#model12

EF_Model8 <- plm(Life.expectancy~
Schooling+HIV.AIDS+BMI+Total.expenditure+Diphtheria+thinness..1.19.years+percentage.expe
nditure+infant.deaths+Adult.Mortality+Alcohol+Measles+Income.composition.of.resources,data=
Pooled_Data, model = 'within', effect = 'individual')

summary(EF_Model8)

#final model(selected)

EF_Modelfinal <- plm(Life.expectancy~
Schooling+HIV.AIDS+Diphtheria+infant.deaths+Adult.Mortality+Alcohol+Measles+Income.com
position.of.resources,data=Pooled_Data, model = 'within', effect = 'individual')

summary(EF_Modelfinal)

#Binary Variables for Countries

#model1

BinCountry_Model1 <- lm(Life.expectancy~Country+Schooling,data=Pooled_Data)

summary(BinCountry_Model1)
```

```
#model2

BinCountry_Model2 <- lm(Life.expectancy~Country+Schooling+HIV.AIDS,data=Pooled_Data)

summary(BinCountry_Model2)

#model3

BinCountry_Model3 <-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality,data=Pooled_Data)

summary(BinCountry_Model3)

#model4

BinCountry_Model4 <-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality+Total.expenditure,data=Po
oled_Data)

summary(BinCountry_Model4)

#model5

BinCountry_Model5 <-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality+Total.expenditure+BMI,dat
a=Pooled_Data)

summary(BinCountry_Model5)

#model6

BinCountry_Model6<-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality+Total.expenditure+BMI+In
come.composition.of.resources,data=Pooled_Data)

summary(BinCountry_Model6)

#model7

BinCountry_Model7 <-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality+Total.expenditure+BMI+In
come.composition.of.resources+thinness..1.19.years+Alcohol+Measles+infant.deaths+percentage.
expenditure,data=Pooled_Data)

summary(BinCountry_Model7)

#final model(selected)
```

```
BinCountry_finalmodel<-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality+Income.composition.of.res
ources+Alcohol,data=Pooled_Data)

summary(BinCountry_finalmodel)

#Binary Variables for time

#model1

BinTime_Model1 <- lm(Life.expectancy~Year+Schooling,data=Pooled_Data)

summary(BinTime_Model1)

#model2

BinTime_Model2<- lm(Life.expectancy~Year+Schooling+HIV.AIDS,data=Pooled_Data)

summary(BinTime_Model2)

#model3

BinTime_Model3 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources,data=Pooled_
Data)

summary(BinTime_Model3)

#model4

BinTime_Model4 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI,data=P
ooled_Data)

summary(BinTime_Model4)

#model5

BinTime_Model5 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinnes
s..1.19.years,data=Pooled_Data)

summary(BinTime_Model5)

#model6
```

```
BinTime_Model6<-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria,data=Pooled_Data)

summary(BinTime_Model6)

#model7

BinTime_Model7<-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria+Total.expenditure,data=Pooled_Data)

summary(BinTime_Model7)

#model8

BinTime_Model8 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria+Total.expenditure+Measles,data=Pooled_Data)

summary(BinTime_Model8)

#model9

BinTime_Model9 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure,data=Pooled_Data)

summary(BinTime_Model9)

#model10

BinTime_Model10 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths,data=
Pooled_Data)

summary(BinTime_Model10)

#model11

BinTime_Model11<-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths+Adult.Mortality,data=Pooled_Data)

summary(BinTime_Model11)
```

```
#model12

BinTime_Model12 <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths+Adult.Mortality+Alcohol,data=Pooled_Data)

summary(BinTime_Model12)

#final model(selected)

BinTime_finalmodel <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+Diphtheria+Measles+percentage.expenditure+Adult.Mortality+Alcohol,data=Pooled_Data)

summary(BinTime_finalmodel)

#Time Demeaned Models

#model1

TF_Model1 <-plm(Life.expectancy~Schooling,data=Pooled_Data, model = 'within', effect =
'time')

summary(TF_Model1)

#model2

TF_Model2 <-plm(Life.expectancy~Schooling+HIV.AIDS,data=Pooled_Data, model = 'within',
effect = 'time')

summary(TF_Model2)

#model3

TF_Model3<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources,data=Pooled_Data,
model = 'within', effect = 'time')

summary(TF_Model3)

#model4

TF_Model4<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI,data=Pooled
_Data, model = 'within', effect = 'time')
```

```
summary(TF_Model4)

#model5

TF_Model5<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years,data=Pooled_Data, model = 'within', effect = 'time')

summary(TF_Model5)

#model6

TF_Model6<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria,data=Pooled_Data, model = 'within', effect = 'time')

summary(TF_Model6)

#model7

TF_Model7 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure,data=Pooled_Data, model = 'within', effect = 'time')

summary(TF_Model7)

#model8

TF_Model8<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles,data=Pooled_Data, model = 'within', effect =
'time')

summary(TF_Model8)

#model9

TF_Model9<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure,data=Pooled_Data,
model = 'within', effect = 'time')

summary(TF_Model9)

#model10
```

```
TF_Model10 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths,data=Pool
ed_Data, model = 'within', effect = 'time')

summary(TF_Model10)

#model11

TF_Model11 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths+Adult.M
ortality,data=Pooled_Data, model = 'within', effect = 'time')

summary(TF_Model11)

#model12

TF_Model12<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths+Adult.M
ortality+Alcohol,data=Pooled_Data, model = 'within', effect = 'time')

summary(TF_Model12)

#final model

TF_Modelfinalmodel<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+Diphtheria+
Measles+percentage.expenditure+Adult.Mortality+Alcohol,data=Pooled_Data, model = 'within',
effect = 'time')

summary(TF_Modelfinalmodel)

#Entity and Time Fixed Models

#model1

ETF_Model1 <- plm(Life.expectancy~Schooling,data=Pooled_Data, model =
'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model1)

#model2

ETF_Model2 <- plm(Life.expectancy~Schooling+HIV.AIDS,data=Pooled_Data, model =
'within',index=c("Country","Year"), effect ='twoways')
```

```
summary(ETF_Model2)

#model3

ETF_Model3 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources,data=Pooled_Data,
model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model3)

#model4

ETF_Model4 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI,data=Pooled
_Data, model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model4)

#model5

ETF_Model5<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years,data=Pooled_Data, model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model5)

#model6

ETF_Model6 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria,data=Pooled_Data, model = 'within',index=c("Country","Year"), effect
='twoways')

summary(ETF_Model6)

#model7

ETF_Model7<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria++Total.expenditure,data=Pooled_Data, model =
'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model7)

#model8
```

```
ETF_Model8 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria++Total.expenditure+Measles,data=Pooled_Data, model =
'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model8)

#model9

ETF_Model9<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria++Total.expenditure+Measles+percentage.expenditure,data=Pooled_Data,
model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model9)

#model10

ETF_Model10 <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths,data=Pool
ed_Data, model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model10)

#model11

ETF_Model11<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+infant.deaths+Adult.M
ortality,data=Pooled_Data, model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Model11)

#finalmodel

ETF_Modelfinalmodel <-
plm(Life.expectancy~Schooling+HIV.AIDS+Diphtheria+Measles+Adult.Mortality+Alcohol,data
=Pooled_Data, model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Modelfinalmodel)

#First Difference Model

#model1
```

```
FD_Model1 <- plm(Life.expectancy~Schooling,data=Pooled_Data,
index=c("Country","Year"),model = 'fd')

summary(FD_Model1)

#model2

FD_Model2<- plm(Life.expectancy~Schooling+HIV.AIDS,data=Pooled_Data,
index=c("Country","Year"),model = 'fd')

summary(FD_Model2)

#model3

FD_Model3<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources,data=Pooled_Data,
index=c("Country","Year"),model = 'fd')

summary(FD_Model3)

#model4

FD_Model4<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI,data=Pooled
_Data, index=c("Country","Year"),model = 'fd')

summary(FD_Model4)

#model5

FD_Model5<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years,data=Pooled_Data, index=c("Country","Year"),model = 'fd')

summary(FD_Model5)

#model6

FD_Model6<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria,data=Pooled_Data, index=c("Country","Year"),model = 'fd')

summary(FD_Model6)

#model7
```

```
FD_Model7<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles,data=Pooled_Data,
index=c("Country","Year"),model = 'fd')

summary(FD_Model7)

#model8

FD_Model8<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure,data=Pooled_Data,
index=c("Country","Year"),model = 'fd')

summary(FD_Model8)

#model9

FD_Model9<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+Adult.Mortality,data=P
ooled_Data, index=c("Country","Year"),model = 'fd')

summary(FD_Model9)

#model10

FD_Model10<-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.
19.years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+Adult.Mortality+Alcoh
ol,data=Pooled_Data, index=c("Country","Year"),model = 'fd')

summary(FD_Model10)

#final model

FD_Modelfinalmodel<-
plm(Life.expectancy~Schooling+HIV.AIDS++Total.expenditure+Adult.Mortality,data=Pooled_D
ata, index=c("Country","Year"),model = 'fd')

summary(FD_Modelfinalmodel)

#random effect model1

#model
```

```
RF_Model1 <- plm(formula
=Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.
years+Diphtheria+Total.expenditure+Measles+percentage.expenditure+Adult.Mortality+Alcohol ,
data = Pooled_Data, model = "random", index = c("Country", "Year"))

summary(RF_Model1)

#final random effect

RF_Modelfinal<- plm(formula
=Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.
years+Diphtheria+Measles+percentage.expenditure+Adult.Mortality , data = Pooled_Data, model
= "random", index = c("Country", "Year"))

summary(RF_Modelfinal)

#final choices in all method

#pooling model

Pooled_Data<-pdata.frame(datafinal,index=c("Country","Year"))

Pooled_modelfinal <-
plm(Life.expectancy~Schooling+Income.composition.of.resources+BMI+percentage.expenditure
+HIV.AIDS+thinness..1.19.years+Diphtheria,data=Pooled_Data, model = 'pooling')

summary(Pooled_modelfinal)

bptest(Pooled_modelfinal)

pbgtest(Pooled_modelfinal)

#random effect model

RF_Modelfinal <- plm(formula
=Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+thinness..1.19.
years+Diphtheria+Measles+percentage.expenditure+Adult.Mortality , data = Pooled_Data, model
= "random", index = c("Country", "Year"))

summary(RF_Modelfinal)

bptest(RF_Modelfinal)

pbgtest(RF_Modelfinal)

#first difference
```

```
FD_Modelfinal <-
plm(Life.expectancy~Schooling+HIV.AIDS++Total.expenditure+Adult.Mortality,data=Pooled_Data, index=c("Country","Year"),model = 'fd')

summary(FD_Modelfinal)

#fixed effect model(within)

ETF_Modelfinal <-
plm(Life.expectancy~Schooling+HIV.AIDS+Diphtheria+Measles+Adult.Mortality+Alcohol,data=Pooled_Data, model = 'within',index=c("Country","Year"), effect ='twoways')

summary(ETF_Modelfinal)

bptest(ETF_Modelfinal)

pbgtest(ETF_Modelfinal)

#time demeand model

TF_Modelfinal <-
plm(Life.expectancy~Schooling+HIV.AIDS+Income.composition.of.resources+BMI+Diphtheria+Measles+percentage.expenditure+Adult.Mortality+Alcohol,data=Pooled_Data, model = 'within', effect = 'time')

summary(TF_Modelfinal)

bptest(TF_Modelfinal, studentize = 'FALSE')

pbgtest(TF_Modelfinal)

#binary variable for time

BinTime_Modelfinal <-
lm(Life.expectancy~Year+Schooling+HIV.AIDS+Income.composition.of.resources+BMI+Diphtheria+Measles+percentage.expenditure+Adult.Mortality+Alcohol,data=Pooled_Data)

summary(BinTime_Modelfinal)

bptest(BinTime_Modelfinal)

#binary variable for Country

BinCountry_Modelfinal <-
lm(Life.expectancy~Country+Schooling+HIV.AIDS+Adult.Mortality+Income.composition.of.resources+Alcohol,data=Pooled_Data)
```

```
summary(BinCountry_Modelfinal)

bptest(BinCountry_Modelfinal)

#ENTITY demeaned

EF_Modelfinal<- plm(Life.expectancy~
Schooling+HIV.AIDS+Diphtheria+infant.deaths+Adult.Mortality+Alcohol+Measles+Income.com
position.of.resources,data=Pooled_Data, model = 'within', effect = 'individual')

summary(EF_Modelfinal)

bptest(EF_Modelfinal)

pbgtest(EF_Modelfinal)

#hausman test

phtest(RF_Modelfinal,ETF_Modelfinal)

#TESTING FOR TIME FIXED EFFECT

plmtest(TF_Modelfinal,c("time"),type=("bp"))

pFtest(TF_Modelfinal,EF_Modelfinal)

#testing for LM test

plmtest(Pooled_modelfinal,type=("bp"))
```