Introduction to Data Analysis with R

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R codes

```
# 1. Install libraries
install.packages("sjlabelled")
install.packages("dplyr")
install.packages("haven")
install.packages("pheatmap")
install.packages("Hmisc") # Data Imputation


# 2. Load the necessary libraries
library(dplyr)
library(haven)
library(sjlabelled)
library(ggplot2)
library(pheatmap)
library(Hmisc)

# 3. Read the data
df <- read_sav("F00011409-Trends_VS_1981_2022_sav_v4_0/Trends_VS_1981_2022_sav_v4_0.sav")
View(df)
str(df)
dim(df)


# Dependent Variable: A025 - Respect and love for parents
# Independent Variables:
# A026 - Parents responsibilities to their children
# A027 - Important child qualities: good manners
# A029 - Important child qualities: independence
# A030 - Important child qualities: hard work
# A032 - Important child qualities: feeling of responsibility
# A034 - Important child qualities: imagination
# A035 - Important child qualities: tolerance and respect for other people
# A038 - Important child qualities: thrift saving money and things
# A039 - Important child qualities: determination perseverance
# A040 - Important child qualities: religious faith
# A041 - Important child qualities: unselfishness
# A042 - Important child qualities: obedience
# A047 - Abortion when child physically handicapped
# A048 - Abortion when woman not married
# A001 - Important in life: Family
# A005 - Important in life: Work
# A006 - Important in life: Religion
# A007 - Service to others important in life
# A058 - Spend time with friends
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# A060 - Spend time with people at your church, mosque or synagogue
# A064 - Belong to social welfare service for elderly, handicapped or deprived people
# A065 - Member: Belong to religious organization
# A066 - Member: Belong to education, arts, music or cultural activities
# A169 - Good human relationships
# A170 - Satisfaction with your life


# 5. Subset The data with selected variables
varstoselect <- c("A025", "A026", "A027", "A029", "A030", "A032", "A034",
                  "A035", "A038", "A039", "A040", "A041", "A042", "A047",
                  "A048", "A001", "A005", "A006", "A007", "A058", "A060",
                  "A064","A065","A066", "A170")
df2 <- df %>%
  select(varstoselect)
df2 %>% dim()

View(df2)

if(!dir.exists("results")){
  dir.create("results")
}
sink("results/label_df2.txt")
df2_labels <- get_label(df2)
print(df2_labels)
str(df2)
sink()


# 6. Data Cleaning
## Checking the number of missing values
colSums(is.na(df2))
colSums(is.na(df2)) %>%  sum()

# 6.1. Descriptive Statistics with NA
sink("results/summary.txt")
df2 %>% summary(na.rm = T)
sink()

# Function for finding the most frequent value
find_mode <- function(x){
  unique_x <- unique(na.omit(x))
  unique_x[which.max(tabulate(match(x, unique_x)))]
}

df3 <- df2
## Loop through the dataframe to impute the NA values with most frequent vlaues
for(col in colnames(df2)){
  mode_value <- find_mode(df2[[col]])
  df3[[col]] <- impute(df[[col]], fun = function(x) mode_value)
}
colSums(is.na(df3))

# 7. Heatmap of Correlations
cor_matrix <- cor(df3, use = "complete.obs")
pheatmap(cor_matrix,
         main = "Correlation Heatmap",
         color = colorRampPalette(c("green", "white", "red"))(100),
         display_numbers = TRUE,   # Show correlation values in the heatmap
         clustering_distance_rows = "euclidean",
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        clustering_distance_cols = "euclidean",
        clustering_method = "complete")


# 8. Linear Regression
independent.vars <- names(df3[,-1])
independent.vars
# Formula of Linear Regression
formula <- as.formula(paste("A025 ~", paste(independent.vars, collapse = " + ")))

# Fitting the linear regression formula
model <- lm(formula, data = df3)
sink("results/regression_summary.txt")
summary(model)
sink()

# 9. Convert all the variables as factors
df4 <- as.data.frame(lapply(df3, factor))

# 10. Summary of the Dataset
sink("results/full_summary.txt")
summary(df4)
sink()

# Barplots for all the variables
create_barplot <- function(df) {
  n <- dim(df)[2]
  if(!dir.exists("/images")) {dir.create("/images")}

  for (i in 1:n) {
    var <- df[, i]
    var.df <- as.data.frame(table(var))
    colnames(var.df) <- c("Categories", "Freq")

    f <- ggplot(var.df, aes(x = Categories, y = Freq)) +
      geom_col(fill = "#0073C2FF", width = 0.3) +
      theme_classic() +
      theme(legend.position = "top") +
      labs(title = paste("Barplot for", colnames(df)[i]))

    ggsave(paste0("/images/my_fig_", i, ".png"), f, width = 6, height = 4, units = "in")
    print(f)
  }
}
create_barplot(df4)
```

1. Research Question & Hypothesis

Research Question:

“How do different child-rearing values and parental responsibilities influence respect and love for parents.”

Hypothesis:

$\boldsymbol{H_0}$: There is no significant relationship between child-rearing values (Important child qualities) and respect and love for parents.

$\boldsymbol{H_1}$: There is a significant relationship between child-rearing values (important child qualities) and respect and love for parents.

2. Data Overview

The dataset is a comprehensive collection of survey data compiled from the European Values Study (EVS) and the World Values Surveys (WVS). This dataset includes 452 surveys conducted across 115 countries and territories, offering a broad representation of social, cultural, and political values worldwide.

Data Description

- Dataset Name: WVS 1981-2022 trend file
- Source: Common EVS/WVS Dictionary (2021)
- Data Dimension: **442473** x **732**
- Timeframe: 1981–2022
- Dimension of Selected Data: **442473** x **25**

2.1 Composition of the IVS 1981-2022

Table 1: Composition of the IVS 1981-2022 dataset

	IVS	EVS Trend File	WVS Trend File
Survey period	1981-2022	1981-2017	1981-2022
Number of waves	7	5	7
Number of cases	663.965	224.434	442.473
Number of variables	838	635	732
Countries/ territories	120	49	108
Number of surveys	464	160	306

2.3 Selected Key Variables & Justification

Table 2: Description of the selected variables in the dataset for analyses.

Variable Name	Description	Role in Analysis
A025	Respect and love for parents	Dependent
A001	Important in life: Family	Independent
A005	Important in life: Work	Independent
A006	Important in life: Religion	Independent
A007	Service to others important in life	Independent
A026	Parents responsibilities to their children	Independent
A027	Important child qualities: good manners	Independent
A029	Important child qualities: independence	Independent
A030	Important child qualities: hard work	Independent
A032	Important child qualities: feeling of responsibility	Independent
A034	Important child qualities: imagination	Independent
A035	Important child qualities: tolerance and respect for other people	Independent
A038	Important child qualities: thrift saving money and things	Independent
A039	Important child qualities: determination perseverance	Independent
A040	Important child qualities: religious faith	Independent
A041	Important child qualities: unselfishness	Independent
A042	Important child qualities: obedience	Independent
A047	Abortion when child physically handicapped	Independent
A048	Abortion when woman not married	Independent
A058	Spend time with friends	Independent

A060	Spend time with people at your church, mosque or synagogue	Independent
A064	Belong to social welfare service for elderly, handicapped or deprived people	Independent
A065	Member: Belong to religious organization	Independent
A066	Member: Belong to education, arts, music or cultural activities	Independent
A170	Satisfaction with your life	Independent

2.4 Data Cleaning & Preprocessing

Handling Missing Values

In the selected dataset, there were a number of missing values. These missing values were imputed using the most frequent values for each variable. Missing value imputation was conducted using the R package Hmisc. This method ensures that the missing data is replaced with the value that occurs most frequently in the respective column, preserving the overall distribution of the data.

3. Descriptive Statistics & Visualizations

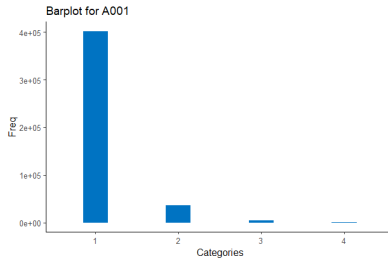
3.1 Descriptive Statistics of the Variables

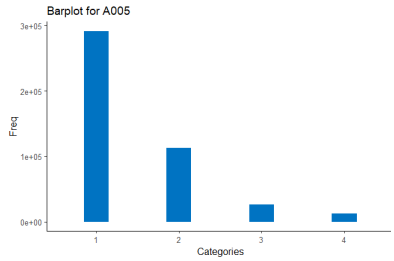
The descriptive statistics of the variables are presented in the Table 3. The total number of observations are 442,473. Among 732 variables only 25 were selected for the analyses. Figure 1. represent the barplots of these variables.

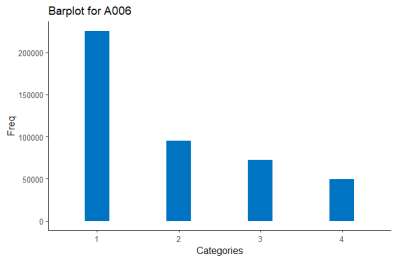
Table 3: Frequency distribution of the selected variables.

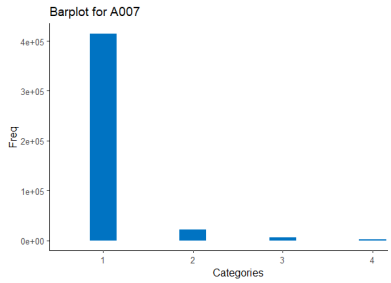
Variable Name	Frequencies	
A025	1	419439
	2	23034
A001	1	401312
	2	36193
	3	3909
	4	1059
A005	1	290981
	2	112539
	3	26107
	4	12846
A006	1	225174
	2	95215
	3	72278
	4	49806
A007	1	414116
	2	21171
	3	5776
	4	1410
A026	1	401888
	2	31929
	3	8656
A027	0	5391
	1	388557
A029	0	238400
	1	204073
A030	0	193869
	1	248604
A032	0	138620
	1	303853
A034	0	351064
	1	303853
A035	0	351064
	1	91409
A038	0	286099
	1	156374
A039	0	286835
	1	155638
A040	0	273008

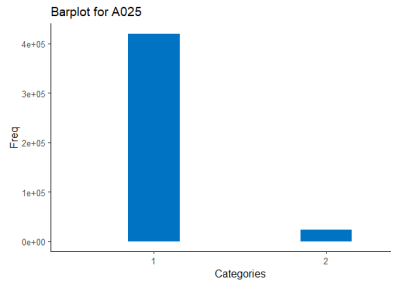
	1	169465
A041	0	310430
	1	132043
A042	0	273318
	1	169155
A047	0	6119
	1	436354
A048	0	435614
	1	6859
A058	1	414955
	2	17384
	3	6938
	4	3196
A060	1	16086
	2	8682
	3	9219
	4	408486
A064	0	438312
	1	4161
A065	0	395431
	1	47042
A066	0	416229
	1	26244
A170	5	60272
	6	48722
	7	66430
	8	86720
	9	44383
	10	61717
	Other	74229
	Total	442,473

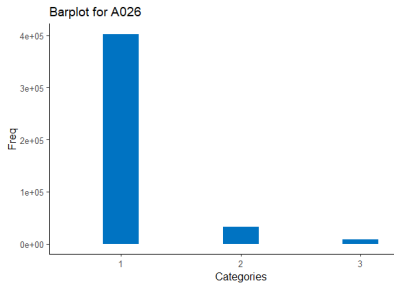


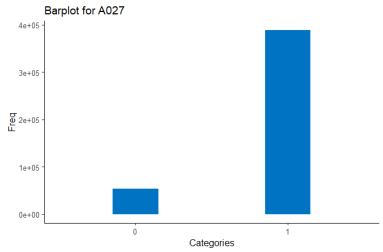


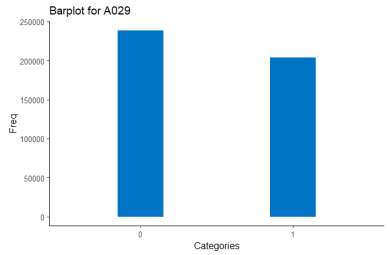


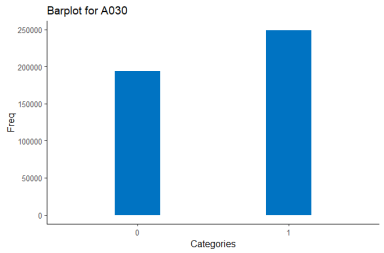












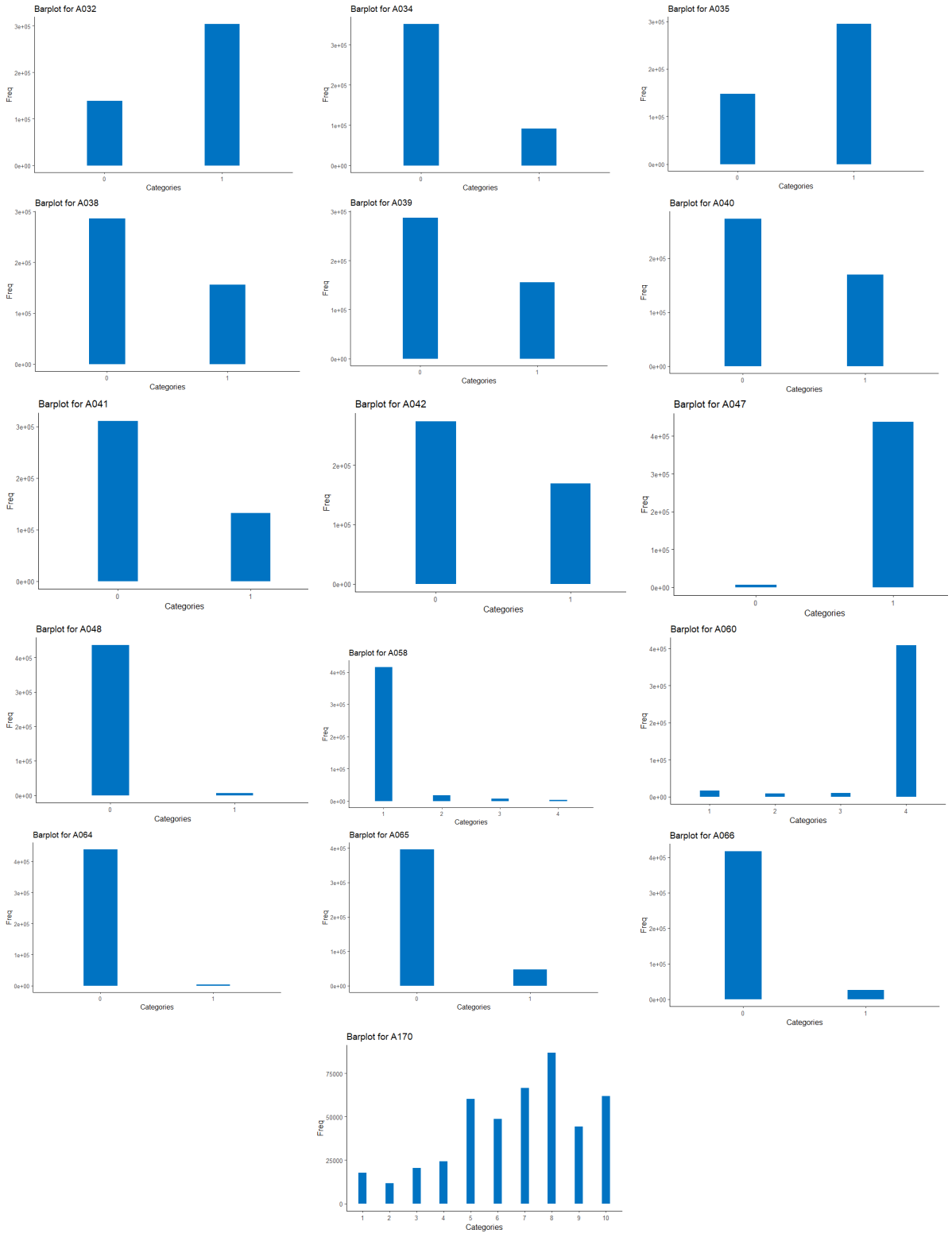


Figure 1: Barplots of the selected variables.

3.2 Correlation among the variables

This correlation heatmap visualizes the relationships between different variables, with red indicating positive correlations and green indicating negative correlations. The intensity of the color corresponds to the strength of the correlation, and the values within the cells provide the correlation coefficients. The dendrograms along the top and left sides reveal clustering patterns among the variables based on their correlation profiles.

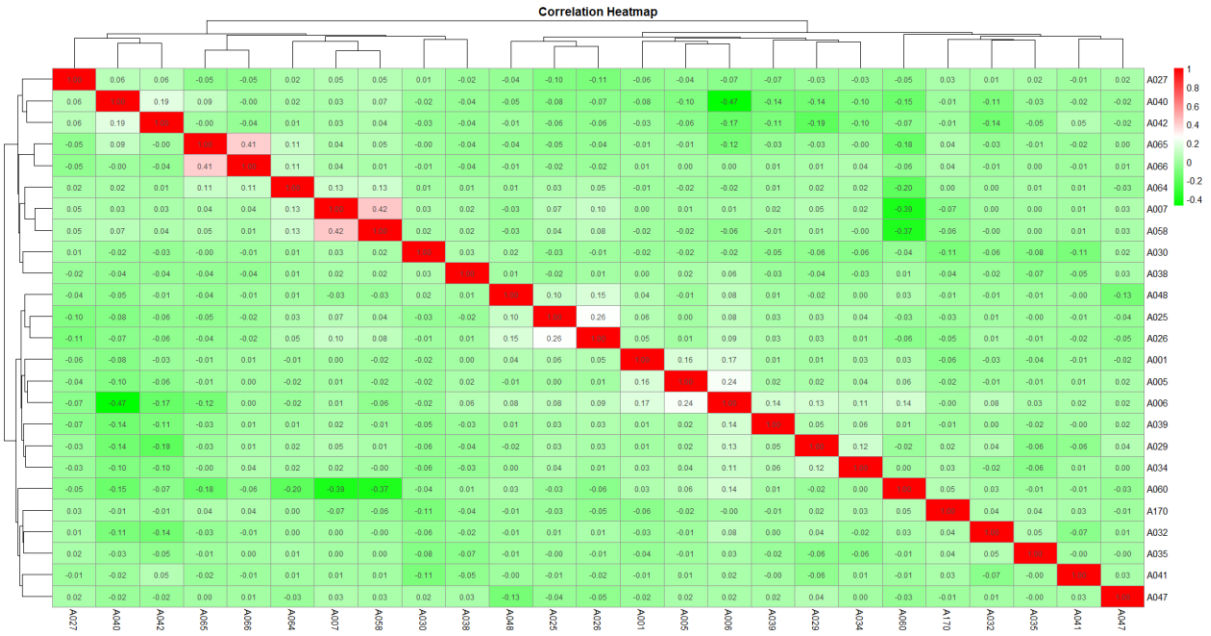


Figure 2: Correlation heatmap of the selected variables.

4. Linear Regression Analysis

After fitting the linear regression model, we evaluated its overall performance using the R-squared (R^2) value, which indicates how well the model explains the variation in the dependent variable. In our case, the R^2 value was 0.08921 meaning that the model explained 8.921% of the variance in the outcome. A higher R^2 indicates a better fit, suggesting that the model does a good job of capturing the relationship between the predictors and the dependent variable.

4.1 Coefficients and Interpretation

In this linear regression analysis, several predictors were evaluated to understand their relationship with the dependent variable. The results show that many of the variables have a significant impact, with their coefficients either positively or negatively affecting the outcome. For instance, the intercept is estimated at 0.990, indicating that when all other predictors are zero, the dependent variable is expected to be around 0.99. Among the predictors, A026 has a large positive effect with a coefficient of 0.132, suggesting that for every one-unit increase in A026, the dependent variable increases by 0.132. On the other hand, A027 shows a negative effect with a coefficient of -0.051, meaning that as A027 increases, the dependent variable decreases by 0.051.

The standard errors of the estimates are generally small, indicating precise estimates for most variables. For example, A026 has a very small standard error of 0.000887, suggesting that its estimate is highly reliable. The t-values, which reflect the ratio of each coefficient to its standard error, are all high, with A026 having a t-value of 148.776, demonstrating its strong significance.

Regarding statistical significance, most variables show highly significant results with p-values less than 2e-16, such as A026, A048, and A001, which all have three asterisks (***), indicating their strong influence on the outcome. Variables like A029 and A032 have p-values of 0.0186 and 0.0019, respectively, showing that they are still significant, though their effects are somewhat less pronounced. In total, the results suggest that the majority of the predictors are significant, with a mix of positive and negative relationships with the dependent variable.

Table 4: Output of the linear regression for the coefficients.

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)	Significance
(Intercept)	0.990002	0.004788	206.76	< 2e-16	***
A026	0.132007	0.000887	148.77	< 2e-16	***
A027	-0.05122	0.000993	-51.57	< 2e-16	***

A029	0.001573	0.000669	2.352	0.018651	*
A030	-0.01611	0.000661	-24.37	< 2e-16	***
A032	-0.00219	0.000704	-3.108	0.001883	**
A034	0.010103	0.000806	12.54	< 2e-16	***
A035	-0.00265	0.000688	-3.853	0.000117	***
A038	-0.01461	0.000676	-21.60	< 2e-16	***
A039	-0.00307	0.000684	-4.49	7.14E-06	***
A040	-0.01631	0.000764	-21.36	< 2e-16	***
A041	-0.00679	0.000708	-9.59	< 2e-16	***
A042	-0.01499	0.000696	-21.53	< 2e-16	***
A047	-0.02965	0.002765	-10.72	< 2e-16	***
A048	0.111625	0.002642	42.255	< 2e-16	***
A001	0.017882	0.00092	19.447	< 2e-16	***
A005	-0.00538	0.000452	-11.91	< 2e-16	***
A006	0.006553	0.000364	18.011	< 2e-16	***
A007	0.025353	0.001059	23.946	< 2e-16	***
A058	0.003615	0.000915	3.952	7.76E-05	***
A060	-0.00691	0.000591	-11.693	< 2e-16	***
A064	0.041245	0.003404	12.116	< 2e-16	***
A065	-0.02573	0.001166	-22.073	< 2e-16	***
A066	-0.00949	0.00149	-6.369	1.90E-10	***
A170	-0.00129	0.000135	-9.579	< 2e-16	***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

5. Conclusion

These produced a number of significant predictors according to the regression analysis, starting from positive toward negatively affecting, most of major variables A026, A048, and A001 appeared as positive effect contributors, while on the opposite side stood A027 A030, A065 with its negative impact. The statistical significance of a great portion of these predictors, while representing very low values of the p-levels, in fact indicates its significant contribution to the explanation of variance in the outcome variable. Still, the estimated R-square is as low as 8.921%, therefore the model provides a very negligible explanation of variation in the dependent variable, showing that though there is a relationship among some significant predictors, possibly there are more important ones left outside the model. The low R-squared value here may indicate that a linear model cannot capture all the intricacies in the data and that nonlinear methods or more predictor variables would be better at giving good predictions. This regression model provides some insight into the key influencing factors, but it has limited explanatory power. It can also be taken forward by future research, focusing on the inclusion of more relevant variables, interaction effects, or even more advanced machine learning models that are superior in predicting the outcome variable.

These results, therefore, do not say much about this question from the model. While some of the predictors related to child-rearing values and responsibilities of parents are significant, the low R-squared value means that the regression model does not perfectly capture the relationship. The research question is thus partially satisfied since other factors that were not considered in this model may be an important determinant in shaping respect and love for parents.

Whenever possible, future work should include relevant variables, try to investigate any nonlinear relationship, or consider alternative modeling in order to provide further insight into how child-rearing values and responsibilities of parents could influence familial relationships.