Contents

PERFORMANCE OF POLISH COMPANIES

ABSTRACT

Company performance is a crucial aspect for any company anywhere in the world. It looks at how effectively the company utilizes working capital and its operations compared to other companies in the same industry. Managers and other stakeholders always take kin interest in company performance to know how to improve or make changes as managers and where to invest as stakeholders. This paper has utilized the "Polish companies' bankruptcy data" trying to assess the performance of these companies. A regression model built using Return on Assets (ROA) as the company performance score shows that polish companies have an average of 14% ROA. A ROA of below 5% is usually considered low by financial experts. However, this may not always be the case. ROA depends on the industry the company in question is operating and the general performance of that particular industry.

INTRODUCTION

This paper intends to build a regression model to predict a company's performance using given performance criteria. It contains the following sections; Introduction, Literature review, Model building, Results, Conclusion, Appendix, and References. The data used for analysis is a multivariate Polish bankruptcy data set collected from 2000 to 2013. It contains 64 attributes labeled X1-X64. The full description attached in Appendix *Table 1*.

LITERATURE REVIEW

This section looks at the prior studies on the performance of organizations and its possible relevant measurements. It will look at theoretical evidence that a given performance measure is suitable to be used for this study.

Company Performance measurement is a principal aspect of every business, not only to the owners but also to the stakeholders like bankers, creditors, customers, and the government. Company owners gauge performance on how well an organization is doing and what adjustments or improvements are needed. Company performance measures used in research range from non-financial to financial performance measures. (Kopecká, 2018). This project will focus on the best possible indicator of financial performance as a generalization of the polish companies' performance.

Financial performance indicators aim at revealing the financial health of an organization. These measures include mainly financial ratios, for example, return on assets (ROA), return on equity (ROE), credit ratio (CR), return on investment (ROI), and many others. According to Aliabadi, Dorestani, and Balsara, 2013, financial measures are mainly based on profit and return on capital invested. The argument is that while it's advantageous to focus on improving given financial performance measures short term, it may not be advisable and efficient for the organization's long-term success. All this is because of the assumption that financial measures encourage short-termism, which shouldn't be the ultimate goal for any organization.

Financial health guides the evaluation of a firm's undertakings in monetary terms. Reflection on this is in the firm's return on investment, return on assets, and value-added. However, ROA offers a different take on management effectiveness and reveals how much profit a company earns for every dollar of its resources invested. (Mahruf and Ahmed, 2020). (Almehdawe, Khan, Lamsal, & Poirier, 2021) and (Aliabadi, Dorestani, and Balsara, 2013) argue that of all financial ratios used in indicating the financial soundness of an organization, ROA is the most relevant. ROA is commonly used in most financial performance literature and is ranked among the top factors by survey participants and stressed by interview participants. Based on this theoretical evidence, this paper uses ROA as an indicator of financial health for the polish companies, making it the dependent variable for this study.

METHODOLOGY/MODEL BUILDING

This section will focus on data cleaning, analysis, and model building. Data cleaning involves dealing with missing observations in the data and possible outliers.

The model built is a multiple linear regression where X1-Return on assets (ROA) is the dependent variable. During data analysis, I run correlation analysis meant to ascertain the significance of the causal relationship between the independent variable and ROA and to eliminate those with multi-collinearity.

The backward approach model building is employed. The base model has all variables inclusive. Elimination of variables is done based on ordinary least squares assumptions. The paper tests for the non-linearity effect in the model building. Below is the formula for Return on Assets (ROA)

$$ROA = \frac{Net\ income/profits}{total\ Assets}$$

TESTING FOR MODEL ACCURACY

The accuracy is defined by how correctly the model generated can predict the ROA for a new company joining the list. In our case, the accuracy is *0.8789248, approximately 88%.*

RESULTS

Statistical Interpretation

From the summary of the regression model attached as *table 2* in the appendix, variables x6, x36, x48, and x59 have a positive relationship with ROA. An increase in these variables leads to an increase in ROA. Whereas variables x15, x25, x29, x55, and x61 have a negative relationship with ROA, implying that as these variables increase, ROA decreases.

Figure 1 from *Appendix 2.1* shows that residuals of the model are moderately linear hence holding for the linearity assumption for the residuals.

Figure 2 from *Appendix 2.2* shows that most residuals spread out around the fitted line. Observation 577 would be a worry since it's miles off the fitted line, which might cause a concern.

Figure 3 from *Appendix 2.3* shows that the residuals randomly spread around the fitted line.

Figure 4 from *Appendix 2.4* shows that almost all observations are well inside the cook's distance hence no major influential cases. Still, cases 577, 1151, and 37777 are of a slight worry, but the model should do well in predicting ROA.

Managerial Interpretation

A manager in charge of any of the polish companies in this industry should increase the output/ratios of variables x6, x36, x48, and x59 to realize a better ROA and decrease variables/ratios x15, x25, x29, x55, and x61 to improve ROA.

APPENDIX

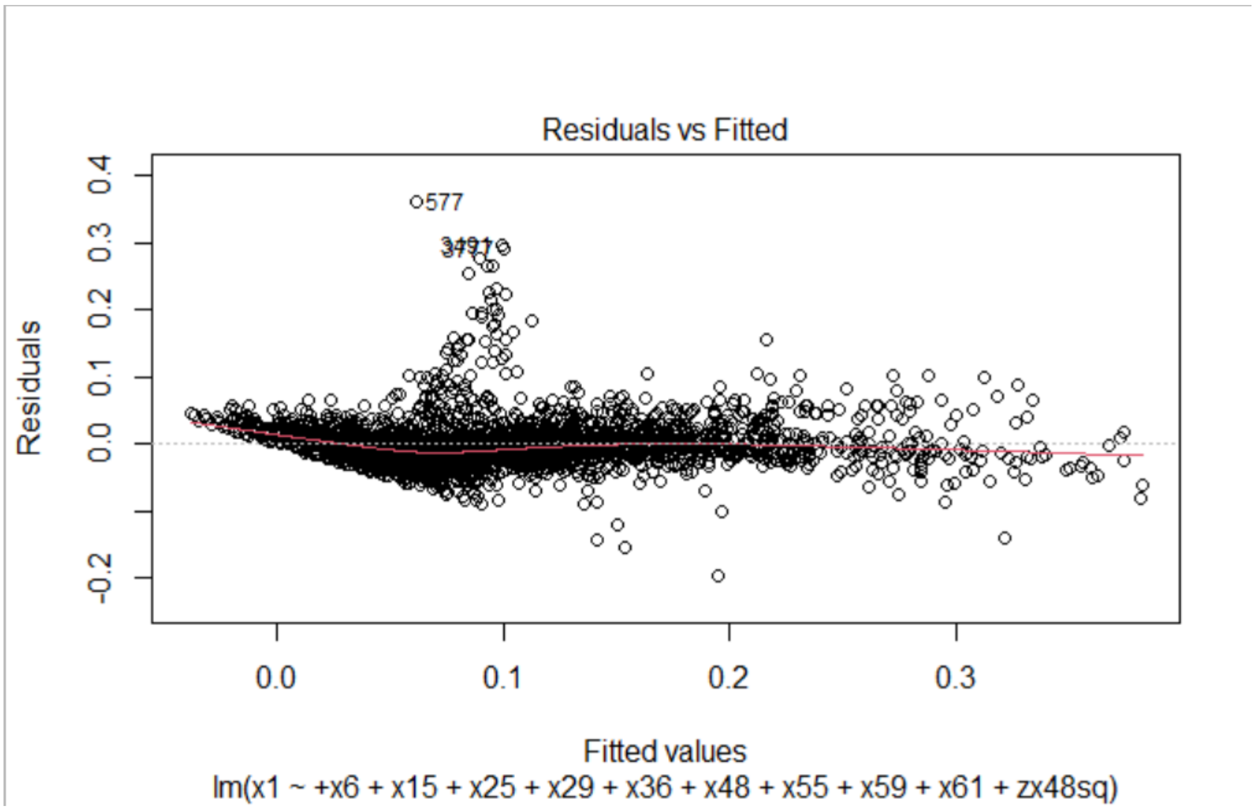
1.0 Table 1

ID	Description	ID	Description
X1	net profit / total assets	X33	operating expenses / short-term liabilities
X2	total liabilities / total assets	X34	operating expenses / total liabilities
X3	working capital / total assets	X35	profit on sales / total assets
X4	current assets / short-term liabilities	X36	total sales / total assets
X5	[(cash + short-term securities + receivables - short-term liabilities) / (operating expenses - depreciation)] * 365,	X37	(current assets - inventories) / long-term liabilities
X6	retained earnings / total assets	X38	constant capital / total assets
X7	EBIT / total assets	X39	profit on sales / sales
X8	book value of equity / total liabilities	X40	(current assets - inventory - receivables) / short-term liabilities
X9	sales / total assets	X41	total liabilities / ((profit on operating activities + depreciation) * (12/365))
X10	equity / total assets	X42	profit on operating activities / sales
X11	(gross profit + extraordinary items + financial expenses) / total assets	X43	rotation receivables + inventory turnover in days
X12	gross profit / short-term liabilities	X44	(receivables * 365) / sales
X13	(gross profit + depreciation) / sales	X45	net profit / inventory
X14	(gross profit + interest) / total assets	X46	(current assets - inventory) / short-term liabilities
X15	(total liabilities * 365) / (gross profit + depreciation)	X47	(inventory * 365) / cost of products sold
X16	(gross profit + depreciation) / total liabilities	X48	EBITDA (profit on operating activities - depreciation) / total assets
X17	total assets / total liabilities	X49	EBITDA (profit on operating activities - depreciation) / sales
X18	gross profit / total assets	X50	current assets / total liabilities
X19	gross profit / sales	X51	short-term liabilities / total assets
X20	(inventory * 365) / sales	X52	(short-term liabilities * 365) / cost of products sold)
X21	sales (n) / sales (n-1)	X53	equity / fixed assets
X22	profit on operating activities / total assets	X54	constant capital / fixed assets
X23	net profit / sales	X55	working capital
X24	gross profit (in 3 years) / total assets	X56	(sales - cost of products sold) / sales
X25	(equity - share capital) / total assets	X57	(current assets - inventory - short-term liabilities) / (sales - gross profit - depreciation)
X26	(net profit + depreciation) / total liabilities	X58	total costs /total sales
X27	profit on operating activities / financial expenses	X59	long-term liabilities / equity
X28	working capital / fixed assets	X60	sales / inventory
X29	logarithm of total assets	X61	sales / receivables
X30	(total liabilities - cash) / sales	X62	(short-term liabilities *365) / sales
X31	(gross profit + interest) / sales	X63	sales / short-term liabilities
X32	(current liabilities * 365) / cost of products sold	X64	sales / fixed assets

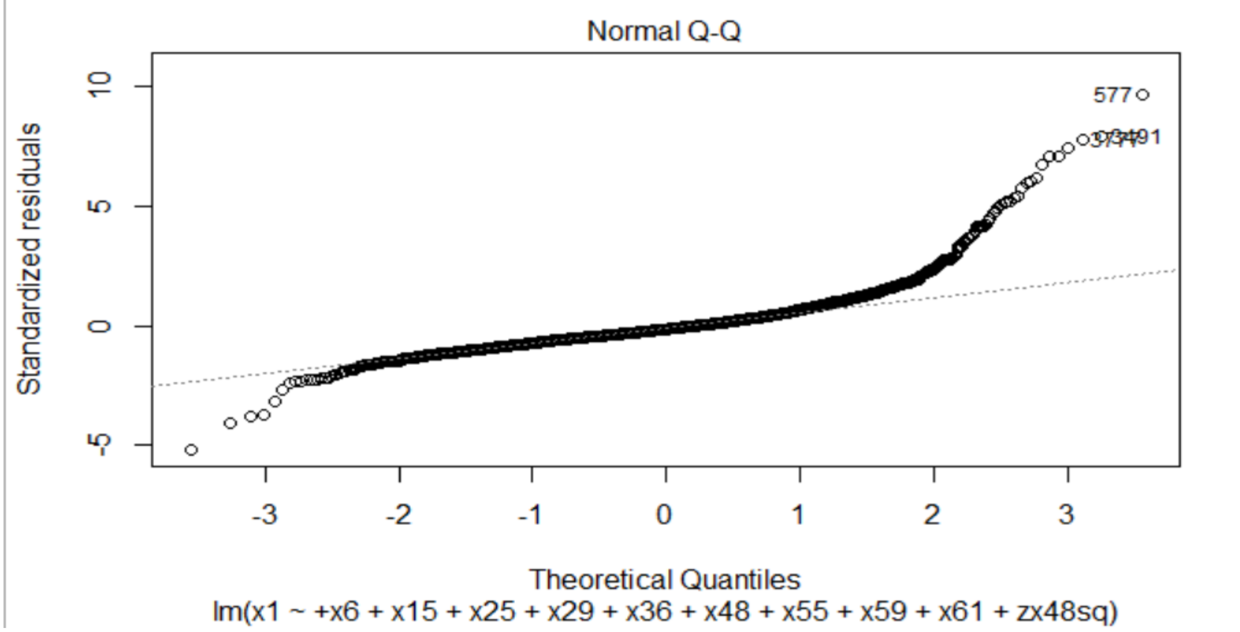
2.0 Table 2

Coefficients:					
	Estimate	Std.Error	t-value	Pr(>|t|)	
(Intercept)	1.39E-01	8.56E-03	16.234	< 2.00E-16	***
x6	6.75E-03	6.82E-03	0.989	0.322649	
x15	-3.07E-05	9.67E-07	-31.709	< 2.00E-16	***
x25	-2.79E-02	4.58E-03	-6.092	1.27E-09	***
x29	-5.45E-03	1.83E-03	-2.975	0.002961	**
x36	3.97E-03	1.11E-03	3.582	0.000347	***
x48	4.09E-01	8.70E-03	47.038	< 2.00E-16	***
x55	-6.09E-07	2.19E-07	-2.779	0.005486	**
x59	9.97E-03	4.65E-03	2.143	0.032231	*
x61	-1.09E-03	2.24E-04	-4.841	1.37E-06	***
zx48sq	1.11E-02	5.30E-04	20.955	< 2.00E-16	***

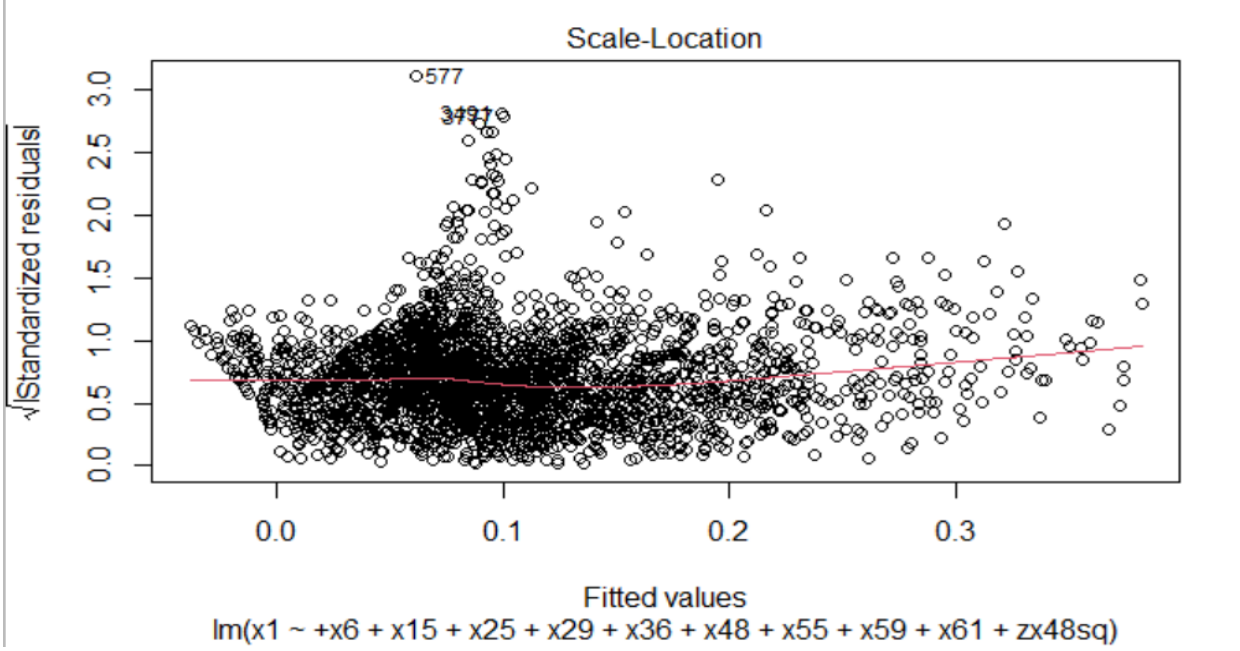
2.1 Figure 1



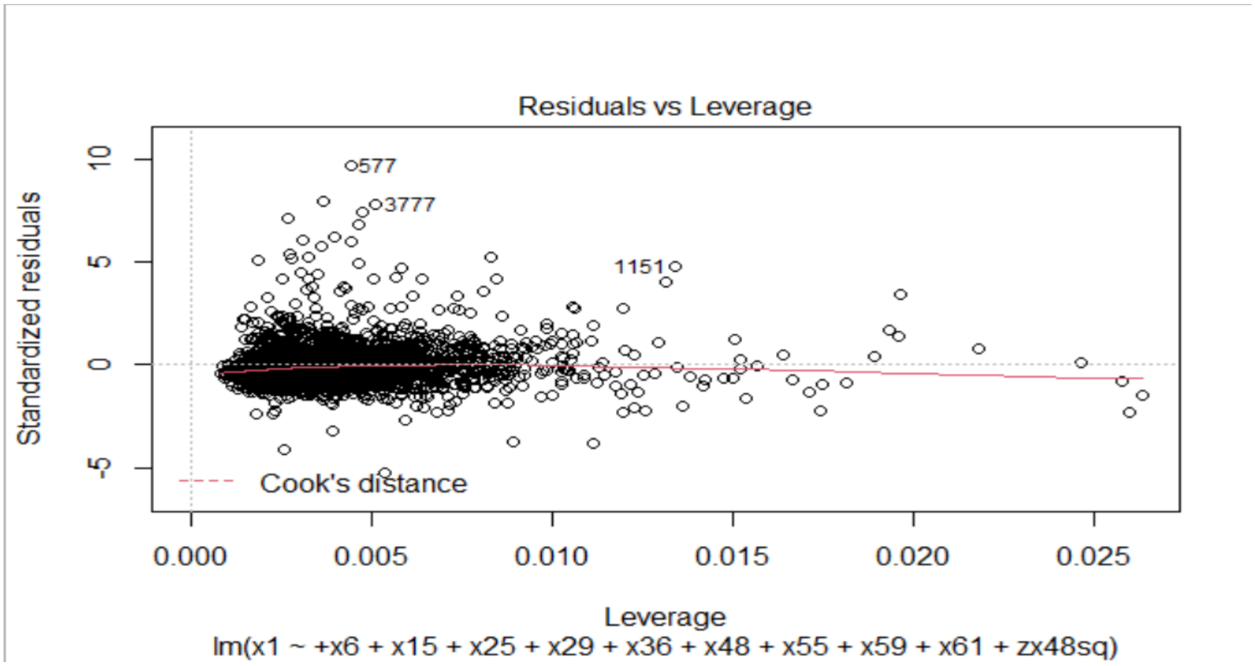
2.2 Figure 2



2.3 Figure 3



2.4 Figure 4



3.00 R-Code

3.01 Importing data-set into R

data <- read.csv(file.choose(), header = TRUE)

3.02 Running required libraries for analysis.

library(car)

library(psych)

library(Hmisc)

library(naniar)

library(corrplot)

library(ggplot2)

library(naniar)

3.03 Checking for missing values.

any_na(data)

n_miss(data)

prop_miss(data)

data %>% is.na() %>% colSums()

3.04 Running correlation

corr_data_x1 <- data[, c(1:49)]

```
corr_data_x1 <- na.omit(corr_data_x1)

oo <- options(max.print=2e+06)

library(Hmisc)

corr_table <- rcorr(as.matrix(corr_data_x1))

corr_table
```

3.05 Eliminating variables due to multi-collinearity and Running correlation on the retained variables.

```
df1 = subset(corr_data_x1, select = c(x1,x3,x4,x5,x6,x9,x12,x15,x16,x23,x25,x26,x29,
                             x34,x36,x38,x46,x48,x50,x51,x55,x57,x59,x61,x63) )

corr_tablecorr_table <- rcorr(as.matrix(df1))

round(cor(df1),
   digits = 2 # rounded to 2 decimals
)
```

3.06 Regression building

First regression model.

```
reg1 <- lm(x1~.,data=df1)

summary(reg1)

coef(reg1)

car::vif(reg1)

plot(reg1)

reg6 <- lm(x1 ~ +x6+x15+x25+x29+x36+x48+x55+x59+x61,data=df2)

summary(reg6)

car::vif(reg6)

plot(reg6)
```

3.07 Checking for Outliers

```
outliersx6<- boxplot(df1$x6, plot=FALSE)$out

outliersx15<- boxplot(df1$x15, plot=FALSE)$out

outliersx25<- boxplot(df1$x25, plot=FALSE)$out

outliersx29<- boxplot(df1$x29, plot=FALSE)$out

outliersx36<- boxplot(df1$x36, plot=FALSE)$out

outliersx48<- boxplot(df1$x48, plot=FALSE)$out

outliersx55<- boxplot(df1$x55, plot=FALSE)$out
```

outliersx59<- boxplot(df1$x59, plot=FALSE)$out

outliersx61<- boxplot(df1$x61, plot=FALSE)$out

3.08 Removing outliers from the data frame (df2) without destroying the original data frame (df1)

df2<-df1

df2<- df2[-which(df2$x6 %in% outliersx6),]

df2<- df2[-which(df2$x15 %in% outliersx15),]

df2<- df2[-which(df2$x25 %in% outliersx25),]

df2<- df2[-which(df2$x29 %in% outliersx29),]

df2<- df2[-which(df2$x36 %in% outliersx36),]

df2<- df2[-which(df2$x48 %in% outliersx48),]

df2<- df2[-which(df2$x55 %in% outliersx55),]

df2<- df2[-which(df2$x59 %in% outliersx59),]

df2<- df2[-which(df2$x61 %in% outliersx61),]

3.09 Testing for non-linearity

df2$zx48 <- scale(df2$x48)

df2$zx48sq <- df2$zx48*df2$zx48

3.10 Final Regression Model

reg7 <- lm(x1 ~ +x6+x15+x25+x29+x36+x48+x55+x59+x61+zx48sq,data=df2)

summary(reg7)

car::vif(reg7)

plot(reg7)

4.11 Accuracy of the model

df2$prediction1 <- predict(reg7, data = df2, type = "response")

mean(abs(df2$prediction1 - df2$x1))

cor(df2$prediction1, df2$x1)

REFERENCES

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