VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY
UNIVERSITY OF ECONOMICS AND LAW
FACULTY OF FINANCE AND BANKING

MID-TERM TEST

Subject: Package of financial application 2

Topic:

APPLICATION OF R PROGRAM LANGUAGE IN ANALYZING FINANCIAL LEVERAGE

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CHAPTER 1: PERFORM LITERATURE REVIEWS

After researching many reports, I have realized some factors that can affect leverage such as: Company size, Company age, The cost of debt, Profitability, Growth, Tangible assets, macro factors (GDP, CPI),...

1.1. Literature review

According to Vithessonthi and Tongurai (2015), the effect of leverage on operating performance is non-monotonic and conditional on company size. In particular, the effect of leverage on performance is positive for small firms. And the effect of leverage on performance is negative for large firms.

Chang, Ding, Lou, Li and Yang (2021) report that book value of leverage is negatively related to firm investment. Market value leverage and debt maturity is positively related to investment. Greater firm size reduces the marginal effects of leverage-investment nexus. Older firm age reduces the marginal effects of leverage-investment nexus.

D'Mello, Gruskin and Kulchania (2018) concluded that managers respond to the changing cost to shareholders by reducing (increasing) leverage when the cost of debt increases (decreases). The time-series pattern in the marginal cost of debt persists after controlling for firm-specific characteristics. They found that macroeconomic factors, such as federal debt, play a role in explaining the marginal value of debt.

Jermias and Yigit (2019) found that firm size and industry median leverage are positively and significantly associated with leverage while profitability and growth opportunities are negatively and significantly associated with leverage.

Kraus and Litzenberger (1973) propose the trade-off theory and argue that in making capital structure decisions, managers make a trade-off between the tax benefits of debt and the expected cost of bankruptcy. This theory predicts that leverage has positive association with firm size, tangible assets and profitability, but has negative association with growth.

According to Midiglinani and Miller (1963), firms with high profitability tend to use more debt. Leverage will be higher in banks with high profitability, because they consider interest payable as a corporate income tax barrier. However, the pecking order theory suggests that managers always have better information about the value of the firm than outside investors. Therefore, the cost of raising capital from outside will be high. Therefore, managers will prioritize using their own capital (retained profit) rather than mobilizing from outside.

Empirical research by Huang & Song (2002), Pandey (2001) found that in high economy countries, business performance is negatively related to debt ratio. The higher a bank's operational efficiency, the more likely the bank is to use equity to finance its operations.
Gropp and Heider (2009) concluded that GDP growth and inflation have a positive effect on financial leverage, and stock market risk has a negative effect on financial leverage.
According to Tran Hung Son (2013), the factors affecting the capital structure of industrial production enterprises include: firm size; tangible fixed assets which are positively correlated to the capital structure of industrial manufacturing enterprises in Ho Chi Minh City and listed industrial production enterprises. Profitability and liquidity are negatively correlated to the capital structure of both groups of industrial enterprises. Fixed asset investment expenditure is positively correlated to the capital structure of listed industrial manufacturing enterprises and negatively correlated to the capital structure of industrial manufacturing enterprises in Ho Chi Minh City. The benefit from non-debt tax is positively correlated to the capital structure of industrial manufacturing enterprises in Ho Chi Minh City, but does not affect the capital structure of listed industrial enterprises. Real income tax of enterprises has a negative impact on the capital structure of listed industrial production enterprises and has no statistical significance for industrial production enterprises in Ho Chi Minh City.

1.2. Discrete variable

With the given data set, I have chosen one discrete variable (Company size) and 2 continuous variables (PPE that represents tangible fixed assets and Current ratio which shows liquidity). Because the data set has already had the market capital variable and total revenue which are conditions to create Company size variable. In addition to the market capital variable, we have current asset variable and current liability variable to calculate the current ratio.

Formulas:

- **Company size**: Decree 80/2021/ND-CP, according to which, the criteria for identifying small, medium and big enterprises are specified as follows:

+ Small company: the total revenue of the year is not more than 50 billion VND or the total capital of the year is not more than 20 billion VND.
+ Medium company: the total revenue of the year is not more than 200 billion VND or the total capital of the year is not more than 100 billion VND.
+ Big company: the total revenue of the year is more than 200 billion VND or the total capital of the year is more than 100 billion VND.

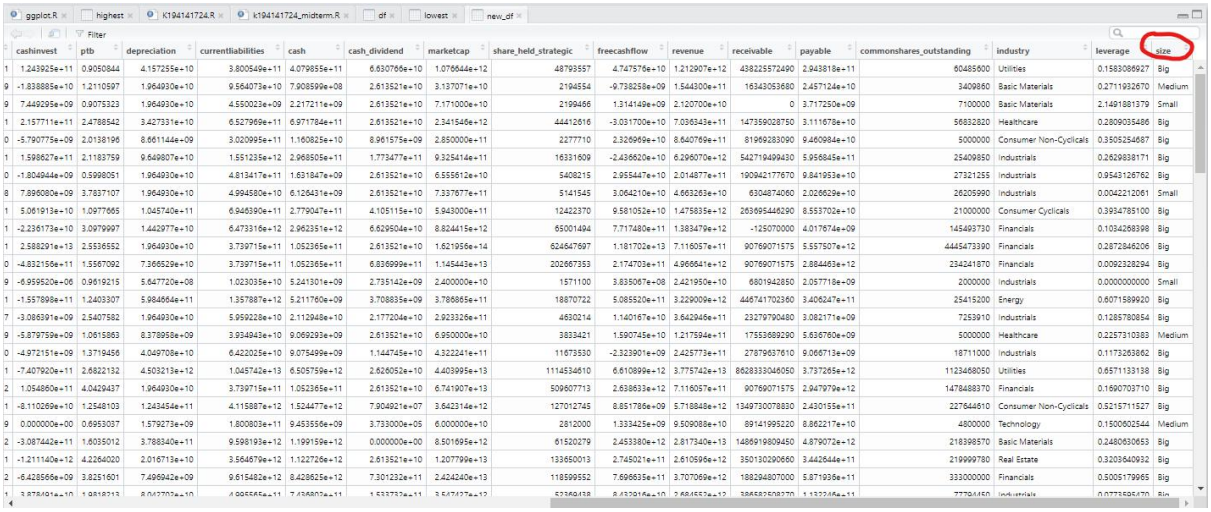
Code:

```
# 'Create Size' variables
size=list()
for (i in rownames(new_df)) {
  if (new_df[i, 'totalequity'] <= 20000000000 | new_df[i, 'revenue'] <= 50000000000) {
    size <- append(size, 'Small')
  } else if (20000000000 < new_df[i, 'totalequity'] & new_df[i, 'totalequity'] <= 100000000000 | 50000000000 < new_df[i, 'revenue'] & new_df[i, 'revenue']
    size <- append(size, 'Medium')
  } else {
    size <- append(size, 'Big')
  }
}
size
length(size)
new_df$size = size  # Append size to data set

sapply(new_df, typeof)   # Check types of data columns

new_df$size = as.character(new_df$size)   # Convert type of list to character
View(new_df)
```

Result:



	cashinvest	ptb	depreciation	currentliabilities	cash	cash_dividend	marketcap	share_held_strategic	freecashflow	revenue	receivable	payable	commonshares_outstanding	industry	leverage	size
1	1.243925e+11	0.9050844	4.157255e+10	3.800549e+11	4.079855e+11	6.630766e+10	1.076644e+12	48793557	4.747576e+10	1.212907e+12	438225572490	2.943818e+11	60485600	Utilities	0.1583086927	Big
9	-1.838885e+10	1.2110597	1.964930e+10	9.564073e+10	7.908599e+08	2.613521e+10	3.137071e+10	2194554	-9.738258e+09	1.544300e+11	16343053680	2.457124e+10	3409860	Basic Materials	0.2711932670	Medium
9	7.449295e+09	0.9075323	1.964930e+10	4.550023e+09	2.217211e+09	2.613521e+10	7.171000e+10	2199456	1.314149e+09	2.120700e+10	0	3.717250e+09	7100000	Basic Materials	2.1491881379	Small
1	2.157711e+11	2.4788542	3.427331e+10	6.527969e+11	6.971784e+11	2.613521e+10	2.341546e+12	44412616	-3.031700e+10	7.036343e+11	147359028750	3.111678e+10	56832820	Healthcare	0.2809035486	Big
0	-5.790775e-09	2.0138196	8.661144e+09	3.020995e+11	1.160825e+10	8.961575e+09	2.850000e+11	2277710	2.326969e+10	8.640769e+11	81969283090	9.460984e+10	5000000	Consumer Non-Cyclicals	0.3505254687	Big
1	1.598627e+11	2.1183759	9.649807e+10	1.551235e+12	2.968505e+11	1.773477e+11	9.325414e+11	16331609	-2.436620e+10	6.296070e+12	542719499430	5.956845e+11	25409850	Industrials	0.2629838171	Big
0	-1.804944e+09	0.5998051	1.964930e+10	4.813417e+11	1.631847e+09	2.613521e+10	6.555612e+10	5408215	2.955447e+10	2.014877e+11	190942177670	9.841953e+10	27321255	Industrials	0.9543126762	Big
8	7.896080e+09	3.7837107	1.964930e+10	4.994580e+10	6.126431e+09	2.613521e+10	7.337677e+11	5141545	3.064210e+10	4.663263e+10	6304874060	2.026629e+10	26205990	Industrials	0.0042212061	Small
1	5.061913e+10	1.0977665	1.045740e+11	6.946390e+11	2.779047e+11	4.105115e+10	5.943000e+11	12422370	9.581052e+10	1.475835e+12	263695446290	8.553702e+10	21000000	Consumer Cyclicals	0.3934785100	Big
1	-2.236173e+10	3.0979997	1.442977e+10	6.473316e+12	2.962351e+12	6.629504e+10	8.824415e+12	65001494	7.717480e+11	1.383479e+12	-125070000	4.017674e+09	145493730	Financials	0.1034258398	Big
1	2.588291e+13	2.5536552	1.964930e+10	3.739715e+11	1.052365e+11	2.613521e+10	1.621956e+14	624647697	1.181702e+13	7.116057e+11	90769071575	5.557507e+12	4445473390	Financials	0.2872846206	Big
0	-4.832156e+11	1.5567092	7.366529e+10	3.739715e+11	1.052365e+11	6.836999e+11	1.145443e+13	202667353	2.174703e+11	4.966641e+12	90769071575	2.884463e+12	234241870	Financials	0.0092328294	Big
9	-6.959520e+06	0.9619215	5.647720e+08	1.023035e+10	5.241301e+09	2.735142e+09	2.400000e+10	1571100	3.835067e+08	2.421950e+10	6801942850	2.057718e+09	2000000	Industrials	0.0000000000	Small
1	-1.557898e+11	1.2403307	5.984664e+11	1.357887e+12	5.211760e+09	3.708835e+09	3.786865e+11	18870722	5.085520e+11	3.229009e+12	446741702360	3.406247e+11	25415200	Energy	0.6071589920	Big
7	-3.086391e+09	2.5407582	1.964930e+10	5.959228e+10	2.112948e+10	2.177204e+10	2.923326e+11	4630214	1.140167e+10	3.642946e+11	23279790480	3.082171e+09	7253910	Industrials	0.1285780854	Big
9	-5.879759e+09	1.0615863	8.378958e+09	3.934943e+10	9.069293e+09	2.613521e+10	6.950000e+10	3833421	1.590745e+10	1.217594e+11	17553689290	5.636760e+09	5000000	Healthcare	0.2257310383	Medium
0	-4.972151e+09	1.3719456	4.049708e+10	6.422025e+10	9.075499e+09	1.144745e+10	4.322241e+11	11673530	-2.323901e+09	2.425773e+11	27879637610	9.066713e+09	18711000	Industrials	0.1173263862	Big
1	-7.407920e+11	2.6822132	4.503213e+12	1.045742e+13	6.505759e+12	2.626052e+10	4.403995e+13	1114534610	6.610899e+12	3.775742e+13	8628333046050	3.737265e+12	1123468050	Utilities	0.6571133138	Big
2	1.054860e+11	4.0429437	1.964930e+10	3.739715e+11	1.052365e+11	2.613521e+10	6.741907e+13	509607713	2.638633e+12	7.116057e+11	90769071575	2.947979e+12	1478488370	Financials	0.1690703710	Big
1	-8.110269e+10	1.2548103	1.243454e+11	4.115887e+12	1.524477e+12	7.904921e+07	3.642314e+12	1270127 45	8.851786e+09	5.718848e+12	1349730078830	2.430155e+11	227644610	Consumer Non-Cyclicals	0.5215711527	Big
9	0.000000e+00	0.6953037	1.579273e+09	1.800803e+11	9.453556e+09	3.733000e+05	6.000000e+10	2812000	1.333425e+09	9.509088e+10	89141995220	8.862217e+10	4800000	Technology	0.1500602544	Medium
2	-3.087442e+11	1.6035012	3.788340e+11	9.598193e+12	1.199159e+12	0.000000e+00	8.501695e+12	61520279	2.453380e+12	2.817340e+13	1486919809450	4.879072e+12	218398570	Basic Materials	0.2480630653	Big
1	-1.211140e+12	4.2264020	2.016713e+10	3.564579e+12	1.122726e+12	2.613521e+10	1.207799e+13	133650013	2.745021e+11	2.610596e+12	350130290660	3.442644e+11	219999780	Real Estate	0.3203640932	Big
2	-6.428566e+09	3.8251601	7.496942e+09	9.615482e+12	8.428625e+12	7.301232e+11	2.424240e+13	118599552	7.696635e+11	3.707069e+12	188294807000	5.871936e+11	333000000	Financials	0.5005179965	Big
1	3.878491e+10	1.9818213	8.042703e+10	4.995565e+11	7.436802e+11	1.533733e+11	3.547427e+12	53360438	8.432916e+10	2.684552e+12	386685508270	1.133246e+11	77784450	Industrials	0.0773598470	Big

The table of data set with 'size' column

Comment:

By this separation, we have 6 small firms, 18 medium firms, and 76 big firms in 2021. Following the previous reports, company size is one of the most important factors affecting leverage positively.

With small firms, the effect of leverage on performance is positive. And the effect of leverage on performance is negative for large firms. We can see it clearly in the plot that allows the combination of ROA, company size and leverage.

1.3. Continuous variable

As I said before, I have chosen 3 continuous variables to identify those variables' effects to leverage and compare with the previous reports. Beside company size, ROA (profitability ratio), PPE (tangible fixed assets), and Current ratio (liquidity ratio) are parts of important variables to leverage. In which:

- **ROA** is negatively correlated with leverage.

Leverage is mainly constituted by total debt to assets, but also by short-term and long-term debt to assets. Meanwhile, profitability is defined as Return on Assets, which indicates how profitable firms are relative to total assets.

Many researches proved that profitability is negatively correlated with financial leverage. Because companies with high business efficiency tend to use internal financing over external financing production and business to achieve higher profitability. This implies that for companies with good business results, shareholders will not want to share this advantage with creditors, because the investment of the business will transfer benefits from shareholders to creditors, bondholders. So that making the capital structure decisions is very important to gain the highest profit which not only optimize useful tax-shield but also maximize the wealth of shareholders.

- **PPE** is positively correlated with leverage.

Companies with a lot of tangible assets often use leverage to finance production and business activities. Those companies may use tangible assets as collateral, either providing more access to creditors or as a guarantee in case of bankruptcy. Especially, long-term leverage is positively correlated with tangible assets which must be financed in a long period for lower costs and long-term interest rate.

- **Current ratio** is negatively correlated with leverage.

Companies with low current ratios are likely not to have enough cash for financing potential projects. Meanwhile, companies with high current ratio are often willing to pay for projects without credit. That is why leverage is an measure to raise fund and have correlation with liquidity.

Formulas:

- Tangible assets = PPE.
- Current ratio = Current assets / Current liabilities.
- ROA is available in the given data set.

CHAPTER 2: PERFORM CODING TASKS

2.1. Create data set

Code:

```r
library(ggplot2) #for plotting
library(tidyverse)  #for data frame manipulation
library(forcats) #for handling factors
library(scales) #for axis scale formatting

require(tidyverse)

## Task 1: Complete in word file
## Import data
library("readxl")
df = read_excel('040522 Data Mid-term test Final.xlsx')
View(df)
df

## Task 2: Create data set
set.seed(724)
new_df <- df[sample(1:752, 100, replace =F), ]
View(new_df)

# Check and fill NA
new_df %>%
  mutate_if(is.numeric, function(x) ifelse(is.na(x), median(x, na.rm = T), x)) -> new_df

# Count the remained missing values
colSums(is.na(new_df))
```

Result:

ggplot.R | K194141724.R | df | new_df | highest | lowest

Filter

	no	firmcode	firmname	exchangename	totalasset	roa	totalcurrentasset	totaldebt	totalequity	ppe	cashopr
1	693	BTP.HM	Baria Thermal Power JSC	HOCHIMINH STOCK EXCHANGE	1.909360e+12	0.0703070243	9.697316e+11	3.022682e+11	1.275278e+12	3.284961e+11	-9.872440e
2	53	MIM.HN	Mineral and Mechanical JSC	HANOI STOCK EXCHANGE	1.242158e+11	0.0603440928	7.954466e+10	3.368650e+10	2.849691e+10	3.615795e+10	1.997646e
3	236	KDM.HN	New Residential Urban Development Holdings Corp	HANOI STOCK EXCHANGE	8.331348e+10	0.0094999994	8.304257e+10	1.790563e+11	7.876346e+10	2.617432e+08	-5.978510e
4	602	DCL.HM	Cuu Long Pharmaceutical JSC	HOCHIMINH STOCK EXCHANGE	1.781028e+12	0.0490062245	1.261155e+12	5.002971e+11	9.702978e+11	4.910296e+11	3.805916e
5	430	CAN.HN	Ha Long Canned Food Joint Stock Corp	HANOI STOCK EXCHANGE	4.547931e+11	0.0690410934	3.900083e+11	1.594166e+11	1.477870e+11	4.526702e+10	-2.542483e
6	171	SCI.HN	SCI E&C JSC	HANOI STOCK EXCHANGE	2.131073e+12	0.0553521197	1.808910e+12	5.604377e+11	4.528357e+11	2.338531e+11	1.152893e
7	550	L62.HN	Lilama 69 - 2 JSC	HANOI STOCK EXCHANGE	5.904914e+11	0.0523535422	4.964571e+11	5.635134e+11	1.060707e+11	9.455711e+10	-2.945895e
8	480	SDA.HN	Simco Songda JSC	HANOI STOCK EXCHANGE	3.430476e+11	0.0665815677	5.353169e+10	1.448075e+09	2.640156e+11	1.028152e+11	-7.422230e
9	288	TVT.HM	Viet Thang Corp	HOCHIMINH STOCK EXCHANGE	1.391242e+12	0.0579952794	8.572866e+11	5.474237e+11	5.637613e+11	4.398005e+11	1.216032e
10	262	FTS.HM	FPT Securities JSC	HOCHIMINH STOCK EXCHANGE	9.455959e+12	0.1316520308	9.254467e+12	9.780000e+11	2.982644e+12	1.502150e+11	1.349472e
11	296	VPB.HM	Vietnam Prosperity Joint Stock Commercial Bank	HOCHIMINH STOCK EXCHANGE	5.474094e+14	0.0237515374	5.874881e+11	1.572623e+14	8.627815e+13	1.216957e+12	5.115790e
12	541	PVI.HN	PVI Holdings	HANOI STOCK EXCHANGE	2.428210e+13	0.0373993480	5.874881e+11	2.241925e+11	7.588791e+12	2.876217e+11	3.183388e
13	120	INC.HN	IDICO Investment Consultancy JSC	HANOI STOCK EXCHANGE	3.616901e+10	0.0697730063	2.878113e+10	0.000000e+00	2.593866e+10	4.879953e+09	4.691594e
14	631	HLC.HN	Vinacomin Ha Lam Coal JSC	HANOI STOCK EXCHANGE	3.096774e+12	0.0209879583	9.040448e+11	1.880234e+12	3.426786e+11	1.922039e+12	7.513683e
15	354	PHN.HN	Hanoi Battery JSC	HANOI STOCK EXCHANGE	1.700972e+11	0.1995200325	1.341386e+11	2.187078e+10	1.105050e+11	1.659594e+10	7.342070e
16	617	MKV.HN	Cai Lay Veterinary Pharmaceutical JSC	HANOI STOCK EXCHANGE	1.085655e+11	0.0723699063	5.990554e+10	2.450661e+10	6.771611e+10	4.780049e+10	-2.456584e
17	668	TCO.HM	Duyen Hai Multi Modal Transport JSC	HOCHIMINH STOCK EXCHANGE	3.775439e+11	0.1489645191	3.632916e+11	4.429587e+10	2.742283e+11	5.865649e+09	-9.515818e
18	308	PGV.HM	Power Generation Joint Stock Corporation 3	HOCHIMINH STOCK EXCHANGE	6.795720e+13	0.0451367658	1.882383e+13	4.465558e+13	1.702765e+13	4.428770e+13	1.296060e
19	326	SSB.HM	Southeast Asia Commercial Joint Stock Bank	HOCHIMINH STOCK EXCHANGE	2.116635e+14	0.0133029457	5.874881e+11	3.578603e+13	1.866326e+13	2.862680e+11	8.570005e
20	116	IDI.HM	I.D.I International Development and Investment Corp	HOCHIMINH STOCK EXCHANGE	7.553859e+12	0.0187716260	5.515278e+12	3.939875e+12	2.988124e+12	1.567710e+12	2.546418e
21	517	TST.HN	Telecommunication Technical Service JSC	HANOI STOCK EXCHANGE	2.861844e+11	-0.0008648038	2.377324e+11	4.294490e+10	8.788588e+10	9.999530e+09	1.329040e

Showing 1 to 21 of 100 entries, 26 total columns

New data frame after filling missing values by median values of the corresponding variables

```
> colSums(is.na(new_df))
                      no                  firmcode                  firmname             exchangename
                       0                         0                         0                         0
             totalasset                       roa          totalcurrentasset               totaldebt
                       0                         0                         0                         0
            totalequity                       ppe                  cashopr                  cashfin
                       0                         0                         0                         0
             cashinvest                       ptb              depreciation       currentliabilities
                       0                         0                         0                         0
                   cash             cash_dividend                 marketcap      share_held_strategic
                       0                         0                         0                         0
            freecashflow                   revenue                receivable                   payable
                       0                         0                         0                         0
commonshares_outstanding                  industry
                       0                         0
```

Result of recounting missing values after filling in the median of missing values.

2.2. Report

2.2.1. 5 firms with highest leverage

Code:

```
27  ## Task 3: Report
28  # Create 'leverage' variable
29  new_df <-new_df %>%
30    mutate(leverage=totaldebt/totalasset)
31  View(new_df)
32
33  # report 5 firms with highest leverage
34  max(new_df$leverage)
35  highest <-new_df[order(new_df$leverage,decreasing=T)[1:5],]
36  View(highest)
37  cat(paste('Top 5 companies with the highest leverage: \n', list(highest$firmname)))
```

Result:

ggplot.R | K194141724.R | df | new_df | highest | lowest

Filter

	no	firmcode	firmname	exchangename	totalasset	roa	totalcurrentasset	totaldebt	totalequity	ppe	cashopr	cashfin
1	236	KDM.HN	New Residential Urban Development Holdings Corp	HANOI STOCK EXCHANGE	8.331348e+10	0.009499999	8.304257e+10	1.790563e+11	7.876346e+10	2.617432e+08	-5.978510e+09	-1.50975
2	550	L62.HN	Lilama 69 - 2 JSC	HANOI STOCK EXCHANGE	5.904914e+11	0.052353542	4.964571e+11	5.635134e+11	1.060707e+11	9.455711e+10	-2.945895e+10	2.06711
3	361	TTE.HM	Truong Thinh Energy Investment JSC	HOCHIMINH STOCK EXCHANGE	1.098618e+12	0.027171798	9.779610e+10	7.709484e+11	2.948420e+11	9.955756e+11	7.919585e+10	1.35506
4	308	PGV.HM	Power Generation Joint Stock Corporation 3	HOCHIMINH STOCK EXCHANGE	6.795720e+13	0.045136766	1.882383e+13	4.465558e+13	1.702765e+13	4.428770e+13	1.296060e+12	-7.69237
5	636	HCM.HM	Ho Chi Minh City Securities Corp	HOCHIMINH STOCK EXCHANGE	2.436910e+13	0.062242365	2.418671e+13	1.503987e+13	7.325253e+12	3.667485e+10	-3.070490e+12	1.00876

The table of 5 firms with highest leverage

```
> cat(paste('Top 5 companies with the highest leverage: \n', list(highest$firmname)))
Top 5 companies with the highest leverage:
 c("New Residential Urban Development Holdings Corp", "Lilama 69 - 2 JSC", "Truong Thinh Energy Investment JSC", "Power Genera
tion Joint Stock Corporation 3", "Ho Chi Minh City Securities Corp")
```

2.2.2. 5 firms with lowest leverage

Code:

```
39  # report 5 firms with lowest leverage
40  min(new_df$leverage)
41  lowest <-new_df[order(new_df$leverage,decreasing=F)[1:5],]
42  View(lowest)
43  cat(paste('Top 5 companies with the lowest leverage: \n', list(lowest$firmname)))
44
```

Result:

	no	firmcode	firmname	exchangename	totalasset	roa	totalcurrentasset	totaldebt	totalequity	ppe	cashopr	cashfin	cash
1	120	INC.HN	IDICO Investment Consultancy JSC	HANOI STOCK EXCHANGE	3.616901e+10	0.06977301	28781130650	0	2.593866e+10	4879952810	4691593620	-2735141640	
2	652	D2D.HM	Industrial Urban Development JSC No 2	HOCHIMINH STOCK EXCHANGE	1.786012e+12	0.12809423	861452280570	0	1.096996e+12	149087271450	-371298400190	-105625017000	457
3	408	COM.HM	Materials Petroleum JSC	HOCHIMINH STOCK EXCHANGE	5.350988e+11	0.07776818	228016833490	0	4.722540e+11	135474843090	29467414650	-1509752780	-3
4	27	NNC.HM	Nui Nho Stone JSC	HOCHIMINH STOCK EXCHANGE	3.544944e+11	0.10354541	191283256900	0	3.015579e+11	21884764280	66124849650	-39250934820	4
5	465	SFI.HM	Sea & Air Freight International	HOCHIMINH STOCK EXCHANGE	9.336485e+11	0.21402302	689908573930	0	6.162858e+11	77018143760	1609005030	-34711299680	128

The table of 5 firms with lowest leverage

```
> cat(paste('Top 5 companies with the lowest leverage: \n', list(lowest$firmname)))
Top 5 companies with the lowest leverage:
 c("IDICO Investment Consultancy JSC", "Industrial Urban Development JSC No 2", "Materials Petroleum JSC", "Nui Nho Stone JS
C", "Sea & Air Freight International")
```

2.2.3. The name of industries which the firms belong to

Code:

```
# Name of industries which the firms belong to
a=highest$industry
b=lowest$industry
c=c(a,b)
cat(paste('Name of industries which the firms belong to: \n', list(unique(c))))
```

Result:

```
> cat(paste('Name of industries which the firms belong to: \n', list(unique(c))))
Name of industries which the firms belong to:
 c("Basic Materials", "Industrials", "Utilities", "Financials", "Real Estate", "Energy")
```

2.2.4. Descriptive statistics

1/ Discrete variable

Code:

```
# Descriptive statistics
# For discrete variable
new_df %>%
  group_by(size) %>%
  summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))
```

Result:

```
> # Descriptive statistics
> # For discrete variable
> new_df %>%
+   group_by(size) %>%
+   summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))
# A tibble: 3 x 6
  size   mean_lev median_lev max_lev min_lev std_lev
  <chr>     <dbl>      <dbl>   <dbl>   <dbl>   <dbl>
1 Big       0.225     0.180    0.954       0   0.197
2 Medium    0.202     0.206    0.702       0   0.189
3 Small     0.399     0.0236   2.15        0   0.861
```

Comment:

We can see that in two big and medium firm groups, mean values and standard deviations of leverage are stable. And the medians of leverage of those groups move at near corresponding mean values. On the other hand, at small company group, the figures show imbalanced and risky performance of leverage.

Moreover, more than half of large companies tend to use financial leverage at a level below the big group average of leverage (about less than 18% compared to the average of 22.5%). This is consistent with previous studies that large firms prefer to use their own

capital to finance potential projects to increase the wealth of existing shareholders so that shareholders will not want to share this advantage with creditors, as the company's investments will transfer benefits from shareholders to bondholders.

2/ Continuous variable

Code:

```
# For continuous variables
# ROA
median(new_df$roa)
new_df %>%
  mutate(x=cut(new_df$roa,breaks=c(min(new_df$roa), median(new_df$roa), max(new_df$roa)),labels=c("below","above"))) %>%
  group_by(x) %>%
  summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))

# PPE
# Calculate PPE ratio
new_df$ppe = new_df$ppe / new_df$totalasset
median(new_df$ppe)
new_df %>%
  mutate(x=cut(new_df$ppe,breaks=c(min(new_df$ppe), median(new_df$ppe), max(new_df$ppe)),labels=c("below","above"))) %>%
  group_by(x) %>%
  summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))

# Current ratio
# Calculate 'current ratio' variable
new_df$current_ratio = new_df$totalcurrentasset / new_df$currentliabilities
median(new_df$current_ratio)
new_df %>%
  mutate(x=cut(new_df$current_ratio,breaks=c(min(new_df$current_ratio), median(new_df$current_ratio), max(new_df$current_ratio)),labels=c("below","above"))
  group_by(x) %>%
  summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))

```

Result and comment:

- **ROA**

```
> # For continuous variables
> # ROA
> median(new_df$roa)
[1] 0.05235354
> new_df %>%
+   mutate(x=cut(new_df$roa,breaks=c(min(new_df$roa), median(new_df$roa), max(new_df$roa)),labels=c("below","above"))) %>%
+   group_by(x) %>%
+   summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))
# A tibble: 3 x 6
  x     mean_lev median_lev max_lev min_lev std_lev
  <fct>    <dbl>      <dbl>   <dbl>   <dbl>   <dbl>
1 below    0.277      0.209   2.15    0       0.342
2 above    0.178      0.151   0.617   0       0.165
3 NA       0.571      0.571   0.571   0.571  NA
```

It is clear that the higher profitable companies are likely not to use much leverage (exception of the tax-shield purpose). Because the shareholders want to gain all profits from the potential projects without sharing for creditors and bondholders. In addition, standard deviations of leverage of lower profitable companies are much larger than the high profitable others as they operate ineffectively and borrow capital from outsources which have high interest rate leading to negative equity.

- **PPE**

```
> # PPE
> # Calculate PPE ratio
> new_df$ppe = new_df$ppe / new_df$totalasset
> median(new_df$ppe)
[1] 0.1313499
> new_df %>%
+   mutate(x=cut(new_df$ppe,breaks=c(min(new_df$ppe), median(new_df$ppe), max(new_df$ppe)),labels=c("below","above"))) %>%
+   group_by(x) %>%
+   summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))
# A tibble: 3 x 6
  x     mean_lev median_lev max_lev min_lev std_lev
  <fct>    <dbl>      <dbl>   <dbl>   <dbl>   <dbl>
1 below    0.240      0.170   2.15    0       0.327
2 above    0.218      0.193   0.954   0       0.212
3 NA       0.501      0.501   0.501   0.501  NA
```

According to the arguments from previous studies, they consider tangible assets (PPE) to be directly proportional to leverage, but after exporting descriptive statistics, it has not

shown the positive relationship between the two variables. We need to observe the scatter plot below to understand. However, for the group of enterprises with low PPE, the risk of negative equity is higher. In my opinion, I think they are not good at tangible asset investment, capital structure for production and business activities, and have to face many risks and challenges from the market (because the manufacturing and industrial companies are still contributing the most for the Vietnamese economy).

- **Current ratio**

```
> # Current ratio
> # Calculate 'current ratio' variable
> new_df$current_ratio = new_df$totalcurrentasset / new_df$currentliabilities
> median(new_df$current_ratio)
[1] 1.537884
> new_df %>%
+   mutate(x=cut(new_df$current_ratio,breaks=c(min(new_df$current_ratio), median(new_df$current_ratio), max(new_df$current_ratio)),labels
>%
+   group_by(x) %>%
+   summarise(mean_lev=mean(leverage), median_lev=median(leverage), max_lev=max(leverage), min_lev=min(leverage), std_lev=sd(leverage))
# A tibble: 3 x 6
  x     mean_lev median_lev max_lev min_lev std_lev
  <fct>    <dbl>      <dbl>   <dbl>   <dbl>   <dbl>
1 below    0.285      0.263   0.954   0       0.200
2 above    0.175      0.110   2.15    0       0.325
3 NA       0.379      0.379   0.379   0.379   NA
```

It is reasonable that the companies with low liquidity are likely to use more leverage than others with high liquidity because they do not have enough money to finance future projects. Moreover, current ratio is one of the main features to assess repaid ability. So the low liquidity companies are not accepted more credits than others. But the fact that the high profitability companies are threatened by risk of negative equity and default. So they must have a balance between liquidity and repaid ability to gain the highest possible profits.

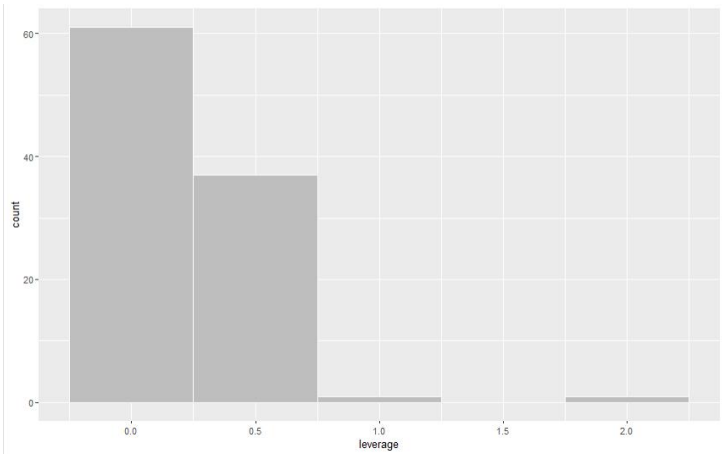
2.3. Visualize data

2.3.1. Histogram of leverage

Code:

```
## Task 4: Data Visualization
# Draw histogram of leverage
ggplot(new_df, aes(x=leverage)) +
  geom_histogram(binwidth=.5, fill='grey', color='white')
```

Result:



Comment:

The degree of financial leverage of 100 companies in the randomly selected data set is from 0 to 2, where the highest leverage density is not more than 0.5. Besides, it has 2 companies that have leverage rates of 1 and 2 have negative equities and risk of default.

2.3.2. Scatter plot of leverage with the continuous variable

Code:

- **ROA**

```
# Draw scatter plot of leverage with the continuous variable
# ROA
new_df %>%
  filter(!is.na(leverage), !is.na(roa)) %>%
  ggplot(aes(x=leverage, y=roa)) +
  geom_point(size=3)
```

- **PPE**

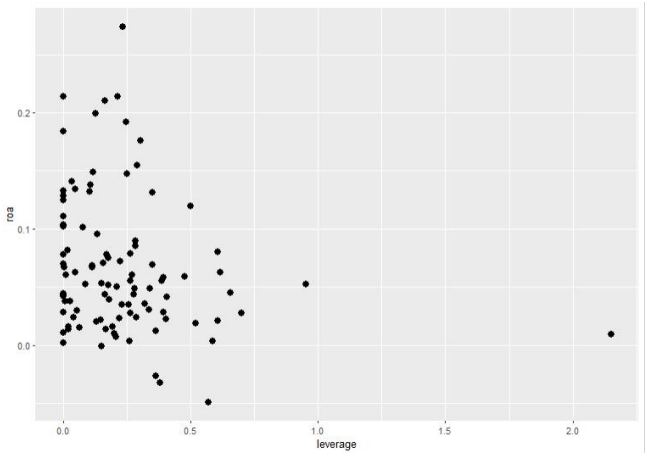
```
# PPE
new_df %>%
  filter(!is.na(leverage), !is.na(ppe)) %>%
  ggplot(aes(x=leverage, y=ppe)) +
  geom_point(size=3)
```

- **Current ratio**

```
124  # Current ratio
125  new_df %>%
126    filter(!is.na(leverage), !is.na(current_ratio)) %>%
127    ggplot(aes(x=leverage, y=current_ratio)) +
128    geom_point(size=3)
```

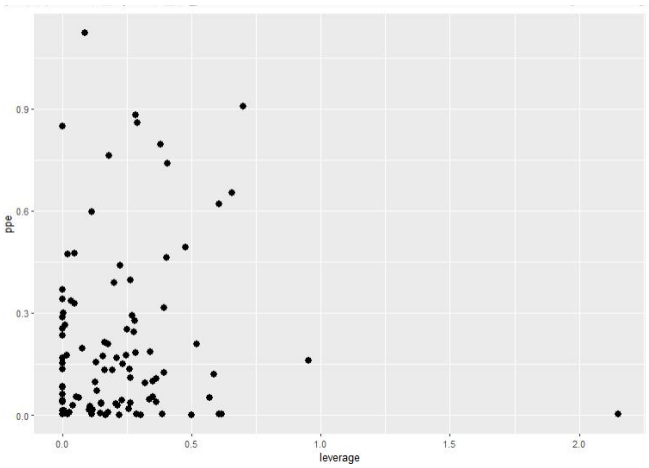
Result and comment:

- **ROA**



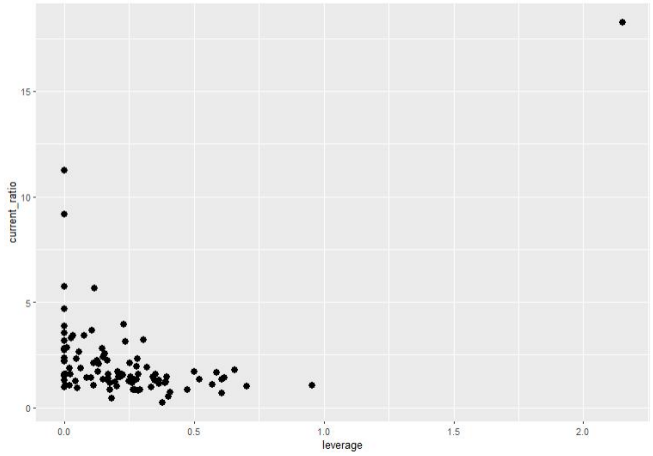
This chart shows that profitability (ROA ratio) is incompletely positively correlated with leverage and the dots tend to expand to the right side. Moreover, most companies at top of profitability have leverage of under 0.5.

- **PPE**



The chart above indicates that tangible asset ratio (PPE) is positively correlated with leverage too because they not only gather at leverage under 0.5 and ppe under 0.3 but also expand to the right side. Especially, the higher the ppe, the larger the rate of leverage they are (exception of several outliers).

- **Current ratio**



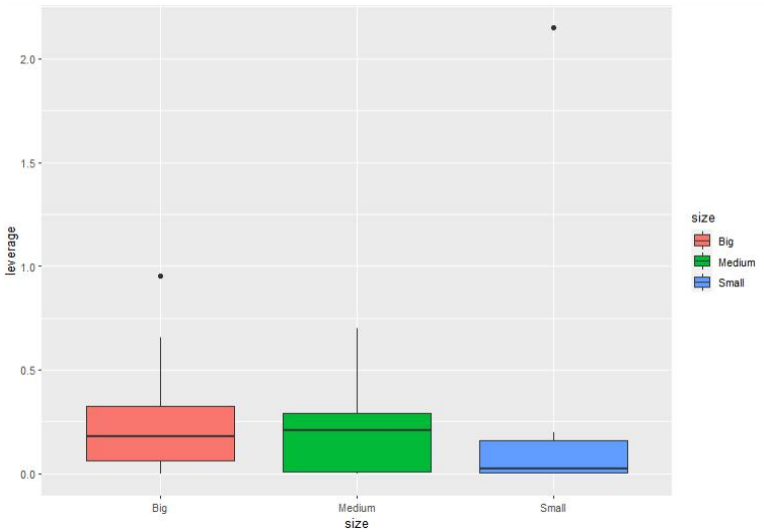
This chart illustrates that liquidity (current ratio) is strongly positively correlated with leverage because when current ratios are at low, most leverage rates are at high (over 0.5). Also, when current ratios are at high, most leverage rates are at low (exception of one outlier). The reason is the company with a high current ratio has already had cash for finance specific projects. And the company with a low current ratio does not have enough cash and equivalents to pay for production so they must borrow. In case of operating ineffectively, they may incur risk of default.

2.3.3. Box plot of leverage with the discrete variable (different color for different categories of discrete variable)

Code:

```
154 # Draw box plot of leverage with the discrete variable (different color for different categories of discrete va
155 new_df %>%
156   filter(!is.na(size), !is.na(leverage)) %>%
157   ggplot(aes(x = size, y = leverage, fill=size)) +
158   geom_boxplot()
```

Result:



Comment:

For the small companies, they lack the most stability. Plus, it seems they are having difficulty borrowing, therefore the leverage is near zero. In addition, it has a company with negative equity and risk of default.

For the medium companies, it is a stable group for making credit because most of their leverages gather under 0.25 and their movements are not very wide.

Finally, the big companies are also a stable group and have more credit opportunities than others, as their distribution of leverage is higher than others.

In general, there is a change in the distribution density of leverage between the categories of company size. For the small companies, they have the lower level of leverage. Meanwhile, the big companies have the higher level of leverage. It is similar to previous studies.

2.3.4. A plot that allow the combination of continuous, discrete variables and leverage

Code:

- **ROA**

```
# Draw a plot that allow the combination of continuous, discrete variables and leverage
# ROA
new_df %>%
  filter(!is.na(leverage), !is.na(roa)) %>%
  ggplot(aes(x=leverage, y=roa, color=factor(size))) +
  geom_point(size=3)
```

- **PPE**

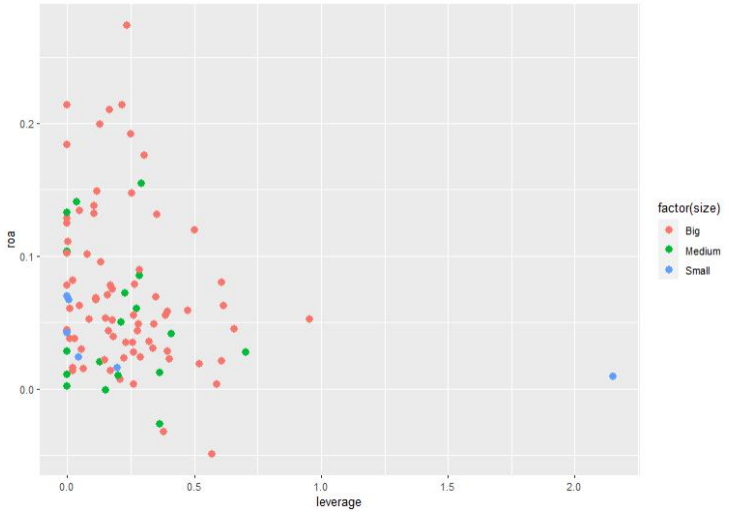
```
# PPE
new_df %>%
  filter(!is.na(leverage), !is.na(ppe)) %>%
  ggplot(aes(x=leverage, y=ppe, color=factor(size))) +
  geom_point(size=2)
```

- **Current ratio**

```
# Current ratio
new_df %>%
  filter(!is.na(leverage), !is.na(current_ratio)) %>%
  ggplot(aes(x=leverage, y=current_ratio, color=factor(size))) +
  geom_point(size=3)
```

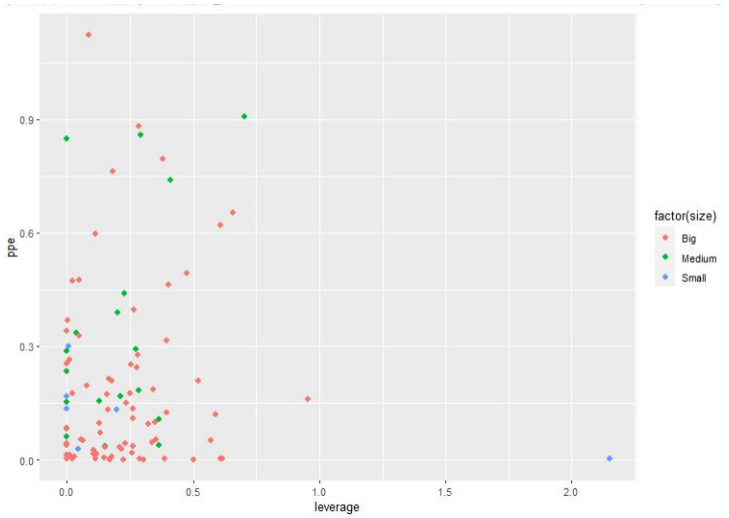
Result and comment:

- **ROA**



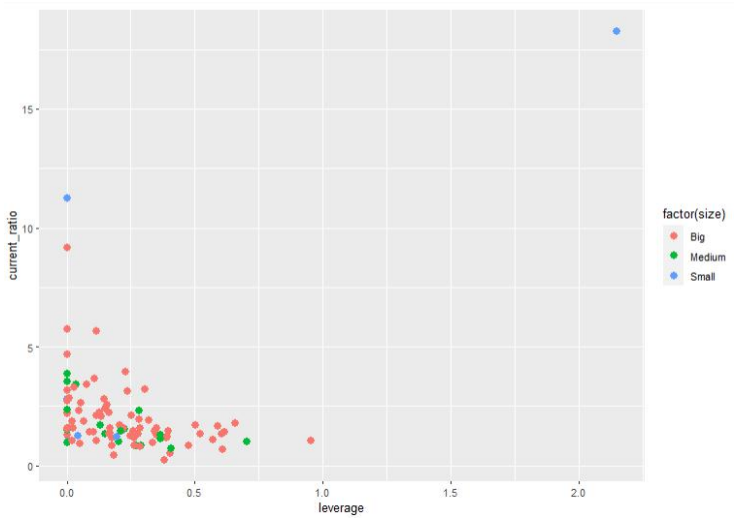
In this chart, we can see that the small companies' performances are not good. They have low ROA ratios (under 0.1) and low leverage rates, especially a small company with a nearly zero ROA ratio and a highest leverage rate (over 2.0). On the other hand, the medium and big firms have the same characteristics: The company with the high leverage does not have the high ROA ratio but most high ROA companies (over 0.1) have the low leverage. It seems that those companies are operating productively and promisingly so that their shareholders do not want to call for the outsource's capital.

- **PPE**



In this chart, most small companies have both low PPE and low leverage. Besides, for medium and big companies, PPE is positively correlated with leverage because those dots expand to the right side, that means the increasing of PPE makes leverage rise too.

- **Current ratio**



The picture above proves strongly that current ratio is negatively correlated with leverage. As for the medium and big firms, the lower the current ratio, the higher the leverage they are and vice versa. For the small-firm, they have the lack of credit allowance and this negative correlation is unclear due to the small observation data set.

2.3.5. Conclusion

After visualizing the data, I found that it is similar to previous reports. Company size and tangible assets (PPE) are positively correlated with leverage. Meanwhile, profitability (ROA) and liquidity (current ratio) are negatively correlated with leverage. Personally, current ratio is the strongly positively correlated variable to leverage. If the data set is large enough, it is promising to make a clear and reliable result.

2.4. Use loop

2.4.1. Count the number of firms in an industry

Code:

```
## Task 5:
# Count the number of firms in a identified industry
ind = readline(prompt = "Please enter a industry name : ")
num=0
for (i in rownames(new_df)) {
  if (new_df[i, 'industry'] == ind) {
    num=num+1
  }
}
print(paste('The number of ', ind, 'companies is: ', num))
```

Result:

```
> ## Task 5:
> # Count the number of firms in a identified industry
> ind = readline(prompt = "Please enter a industry name : ")
Please enter a industry name : Utilities
> num=0
> for (i in rownames(new_df)) {
+   if (new_df[i, 'industry'] == ind) {
+     num=num+1
+   }
+ }
> print(paste('The number of ', ind, 'companies is: ', num))
[1] "The number of  Utilities companies is:  6"
```

2.4.2. Count the number of firms in an industry and with leverage above a certain value

Code:

```
# Count the number of firms in an industry and with leverage above a certain value
ind = readline(prompt = "Please enter a industry name : ")
pct = as.numeric(readline(prompt = 'PLease enter a percentage value: '))
num=0
for (i in rownames(new_df)) {
  if (new_df[i, 'industry'] == ind & new_df[i, 'leverage'] > pct) {
    num=num+1
  }
}
print(paste('The number of ', ind, 'companies which has the higher leverage value of', pct, 'is: ', num))
```

Result:

```
> # Count the number of firms in an industry and with leverage above a certain value
> ind = readline(prompt = "Please enter a industry name : ")
Please enter a industry name : Utilities
> pct = as.numeric(readline(prompt = 'PLease enter a percentage value: '))
PLease enter a percentage value: 0.2
> num=0
> for (i in rownames(new_df)) {
+   if (new_df[i, 'industry'] == ind & new_df[i, 'leverage'] > pct) {
+     num=num+1
+   }
+ }
> print(paste('The number of ', ind, 'companies which has the higher leverage value of', pct, 'is: ', num))
[1] "The number of  Utilities companies which has the higher leverage value of 0.2 is:  4"
>
```

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