Masters in Actuarial Science

**Masters Final Work**

Dissertation

# Financial Performance of Pension Funds in Nigeria

Shamsudeen Abiola Aminu

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# Abstract

The main objective of this work is to assess the financial performance of pension funds in Nigeria. It starts by describing the pension schemes operating in the country and the various legislation enacted, and then progresses to focus on variables like the net assets under management, income, and profit before tax, on one hand, and variables like density of contribution, expenditure, age of fund, idle contribution, and retirement savings account membership, on the other hand. Taking these variables, a linear regression approach was attempted to measure the profitability obtained by the pension funds' investments, mainly following the works by Oluoch (2013), Kigen (2016), Ajibade, et al. (2018), and Adekoya, Nwaobia, & Siyanbola, 2022.
The study applied quantitative secondary data collected for 20 pension fund administrators. The sources are the annual financial statements of the administrators and the annual report of the regulator, the National Pension Commission.
Although some of the proposed specifications do not satisfy the regression assumptions, due for instance to the presence of multicollinearity among variables, it was still possible to fit a model that provides useful results. The main conclusions confirm that the density of contribution has a positive significant effect on the financial performance of pension funds in Nigeria, measured by profit before tax, while idle contribution and age of fund have no significant effect on this performance.

**Keywords:** Pension funds' performance, Profit before tax, Contribution density, Idle contribution, Age of fund, Nigeria.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background for the research

Growing up in Nigeria, it was clear that the delay in pension and gratuity payments caused unfathomable agony and even death for many retirees, causing employees to fear retirement. In this setting, retirees have met numerous obstacles, such as problems with planning and management, the exit phase, corruption at the pension board, discrimination by the community, and sudden death. Due to this, workers in public and private sectors in Nigeria today see retirement as the most serious issue (Garba & Mamman, 2014).

Planning retirement is a challenging task everywhere in the world. It may be more challenging for civil servants (government workers) in Nigeria due to their modest income and savings, as well as their large family and community obligations. The size of the family, polygamy, the additional responsibilities of extended family members, and the inaccessibility of medical care are some of the societal factors that influence retirement planning in Nigeria. Pension funds in Nigeria have a long history of blatant corruption, theft, mismanagement, and financial diversion, despite multiple policy amendments governing worker retirement benefits (Garba & Mamman, 2014).

According to Fapohunda (2013), corruption in the pension system has gotten so bad that it has spread to the Nigerian Police Pensions and the Pension Unit of the Office of the National Pension Commission (PENCOM)[1].To mention a few of these, a recent hearing took place in April 2022, where the

[1] National Pension Commission | Regulators of the Nigerian Pension Industry (pencom.gov.ng)

Supreme Court arraigned and prosecuted former assistant pension director in the office of Police pension over ₦22.9 billion fraud (₦ is the symbol for the Nigerian naira, the currency of Nigeria, NGN). Money laundering charges to the tune of ₦2.1 billion was also established to have been perpetrated by a former Chairman of Pension Reform Task Team (PRTT) (Economic and Financial Crimes Commission (EFCC), 2021).

In Nigeria, pension funds must be privately managed by licensed Pension Fund Administrators (PFAs), companies whose sole purpose is the management of pension fund assets.[2] Other important entities are the Pension Fund Custodians (PFCs), responsible for keeping safe custody of pension assets. Among other tasks, they receive contributions, settle transactions and undertake activities relating to the pension fund investments, on behalf of PFAs.[3] The evaluation of the financial performance of PFAs in the context of Nigeria was necessitated by a number of obstacles, in addition to those listed above.

Pension funds act a vital role in the Nigerian economy since they encourage investments and boost the allocation of treasuries to a number of market segments, such as internal bonds, Federal Government of Nigeria securities, treasury bills, and agency bonds (Ajibade, Jayeoba, & Aghahowa, 2018). According to Oluoch (2013), Pension funds have benefited from the expansion of the speculation economy similarly to how the banking industry has. There is no doubt that the Federal Government has planned to borrow money from the Pension funds recently. The Federal Government planned to borrow ₦620 billion from Pension funds to support its proposed ₦7.73 trillion investments in transportation infrastructure over the next five years (The Guardian Newspaper, 2022). The initiative, however, received harsh criticism.

[2] https://www.pencom.gov.ng/pension-fund-administrators/
[3] https://www.pencom.gov.ng/pension-fund-custodians/

The impact of pension funds on economic growth in Nigeria is demonstrated not only by their constantly rising gross domestic product share but also by the fact that they increase gross national savings. The Pension Reform Act of 2004 anticipated that the pension sector would yearly produce over ₦900 billion in long-term loanable capital (Balogun, 2006). According to PENCOM, the country's pension assets hit ₦4.6 trillion in 2014 (News Agency of Nigeria (NAN), 2014). Similar to this, Barungi (2014) asserts that the growth of pension funds has fluctuated, from a deficit of USD 16.3 billion in 2004 to a surplus of USD 19.3 billion in 2012, followed by a rise to approximately USD 23.2 billion in 2013. The industry's asset under management experienced a 20.6% growth from ₦10.2 trillion as at the end of 2019 to ₦12,3 trillion by the end of 2020 and an annual compound growth rate of 18.3% over the last five years (Vanguard Newspaper, 2021). The expansion of the pension industry in the country is being driven by the rise in pension funds contribution, as well as return and capital gains on investments (PENCOM).

According to projections available based on annual growth, pension assets are expected to reach ₦38 trillion by 2024 (Tolu-Kusimo, 2014) and it is necessary and recommended that the Pension Fund Administrators and Pension Fund Custodians increase their competency and capacity to administer and invest this fund pool, namely, by creating additional channels through which these funds can be directed for investment, and providing additional safety precautions and a strong corporate governance structure in the financial sector in Nigeria. In addition, Agusto & Co's 2021 pension research predicts that the industry's net assets would exceed $20 trillion by 2023, with an average growth rate of 18% (in line with the five-year average growth rate of 18.3%) for the following three years leading up to 2023 (Vanguard Newspaper, 2021).

In 2005, the World Bank and the Organization for Economic Cooperation and Development (OECD) collaborated with three private sector organizations (Banco Bilbao Vizcaya Argentaria, Internationale Nederlanden Groep, and the Dutch Association of Industry-wide Pension Funds) to conduct a research program on the issues of potential volatility and unpredictability of retirement income, recognizing the growing importance of measuring the performance of funded pension systems (Hinz, Rudolph, Antolin, & Yermo, 2010).

### 1.2 Objectives of this study

This paper aims to evaluate the effect of pension fund attributes, for instance, the funds size, or the age of funds, on the financial performance of pension fund administrators in Nigeria. Specific research objects include:

- Assess the impact of the total number of registered retirement savings accounts (will be detailed later), on the financial performance of PFAs in Nigeria;
- Assess the effect of the fund expenditure on the financial performance of PFAs in Nigeria;
- Determine the impact of density contributions on the financial performance of PFAs in Nigeria;
- Assess the effect of age of fund on financial performance of PFAs in Nigeria;
- Assess the effect of the idle contribution on the monetary success of PFAs in Nigeria;
- Examine the effect of fund size on the financial performance of PFAs in Nigeria.

Taking these variables, a linear regression approach will be attempted to measure the profitability obtained by the pension funds' investments, mainly following the works by (Oluoch, 2013), (Kigen, 2016), and (Ajibade, et al., 2018), The study will use quantitative secondary data collected for 20 pension fund administrators. The sources are the annual financial statements of the administrators and the annual report of the regulator, the National Pension Commission. The data collection methods and model will be explained in Chapter 3, while Chapter 4 will give an overview of data and results

### 1.3 Operational definitions of terms

**Pension funds:** this is conceptualized as the funds that accumulate capital to be paid out as pension for employees when they retire at the end of their careers. A pension fund entails an institutional investor who invests a large pool of money into private and public companies.

**Pension fund administrator (PFA):** this is a company licensed by the National Pension Commission to manage and invest the pension funds in the employees' Retirement Savings Accounts.

**Retirement Savings Account:** This account is mandated by the Pension Reform Act 2004 to be open by each employee with the PFA of his/her choice, and is the account where the monthly contribution will be credited. An employee is provided with a registration form detailing the individual's personal information by their chosen PFA, the completed form is then presented to PENCOM for issue of a Personal Identification Number (PIN) which uniquely identifies each individual, and the PFA will in turn supply the employee with the account details.[4]

**National Pension Commission:** This is an institution set up by the Pension Reform Act of 2004 as the apex regulator of pension matters in Nigeria. PENCOM is responsible for granting license, approving and regulating the pension fund operators and the industry as a whole.

**Second Pillar Scheme:** These are work-related pension schemes initiated from collective agreement of both the employer and the employee, which are then privately managed.

**Pension fund performance:** This involves the evaluation of the returns made by pension funds within the specified period.

[4] RETIREMENT SAVINGS ACCOUNT (pencom.gov.ng)

## 1.4 Thesis structure

This thesis is divided into two parts to accomplish the underlying objectives: a theoretical part (Chapters 2 and 3) and an application within the context of the Nigeria Pension Fund Administrators (Chapters 4 and 5). Chapter 2 presents the topic of pension schemes and pension funds, with particular attention to the Nigerian case, with the help of the existing relevant literature. Chapter 3 explains the methodology employed for this study, including models, approaches, again based on the existing literature. Chapter 4 and 5 shows the results, discussion and conclusion of the research.

# CHAPTER 2

# PENSION FUNDS IN NIGERIA

## 2.1 Basics on pension funds

Pension funds entail assets that pay employees' retirement obligations. These assets are accumulated from both employees and their respective employers' contributions into their individual retirement savings accounts during their service years. The management and administration of the accumulated funds is the fundamental function of the PFAs who have to invest these contributions cautiously to avoid losing the principal as well as generate sufficient returns. The purpose of these funds is to offer post-retirement benefits in the form of income to contributors who have reached retirement age.

Impavido (2013) defines a Pension Fund as a basket of money savings accumulated during individual work life. Similarly, Wall (2014) defines Pension Fund as an investment fund or pool into which plan participants contribute in order to amass a lump sum for retirement income. Complementing these definitions, Dickson, Hardy, & Waters (2020) state that in a pension plan, the employee pays a fixed contribution, which is added to the employer's contribution. The accumulation of contributions is seen as future retirement benefit.

A pension fund system that is innovative will provide retirees with sufficient income to prevent them from running out of money in later years. Therefore, a pension fund is a sum of money saved while doing work-related duties that will be used to support appropriate and long-lasting health in old age.

## 2.2 Brief history of the provision of retirement income in Nigeria

Following Barrow (2008), Pension plans in Nigeria can be explained by the beginning of organized workforces in the private and governmental sectors during the colonial era of the 20th century. The Pension Ordinance of 1951, which went into force on January 1, 1946, was the first Pension law in Nigeria, and granted British administrators full pension rights and Nigerian colonial government personnel discretionary partial pension rights. This ordinance gave rise to the Pension Act of 1958 and the 'old' Nigerian Pension System.

However, only workers in the public sector were compelled by law to be included in the system, and not all private sector employers had established pension plans. This was due to the lack of a statutory requirement for them to do so. Additionally, those that implemented the pay-off programs, which involved lump sum payments just before retirement, were not legally required to do so (Nnanta, Okoh, & Ugwu, 2011).

Subsequently, the National Provident Fund Scheme was established in 1961, and became the first piece of legislation to address pension related issues in private organizations, where a one-off lump sum benefit is provided to retirees based on their monthly contributions during their service year, as such regarded as a savings scheme. The Armed Forces Pension Act No. 103 of 1979 and the Pension Act No. 102 of 1979 were enacted eighteen (18) years later (Barrow, 2008). Following this was the Pension Act No. 75 of 1987, under which the establishment of pension systems for the police and other government entities was created. The Pension Act No. 75 of 1987 also lead to the establishment of the Local Government Pension Scheme of 1987. The National Social Insurance Trust Fund (NSITF) plan replaced the National Provident Fund scheme on July 1, 1994, after being launched in 1993 to provide an enhanced social protection to employees of the private sector. The goal of NSITF was to protect private sector workers from losing income from their jobs due to old age, incapacity, or death (Sule & Ezugwu, 2009).

Until June 2004, Pension Ordinance of 1951 and Pensions Decrees 102 and 103 of 1979 were Nigeria's public service and military pension legislation. However, in the meanwhile, several government directives and rules were published to modify their terms and conditions. For instance, in 1992, the qualifying period for public servant gratuities and pensions was reduced from 10 to 5 years and from 15 to 10 years, respectively.

The Pension Reform Act of 2004[5] gave prominence to the 'new' pension scheme in Nigeria, which is a defined contribution system, as opposed to the 'old' one that was dominated by defined benefits.

## 2.3 The Nigerian Pension Reform Act (2004)

### 2.3.1 Goals

The goals of the Pension Reform Act (2004) were:

- To ensure that all retirees from the Public Service of the Federation, the Federal Capital Territory, and the Private Sector receive their pensions on time.
- To assist individuals by encouraging them to save for their retirement, thereby minimizing the incidence of old-age poverty.
- To ensure that retirees are not subjected to unimaginable agony as a result of the inefficient and tedious pension payout process.
- To develop a unified set of rules, regulations, and guidelines for the administration and payment of retirement benefits for the Federal Public Service, the Federal Capital Territory, and the Private Sector.

[5] Nigeria_PensionReformAct2004.pdf (pencom.gov.ng)

- To halt the growth of unpaid pension obligations.

### 2.3.2 Operators

The principal operators of Pension Funds are the National Pension Commission, Pension Fund Administrators (PFA), Closed Pension Fund Administrators (CPFA)[6], and Pension Fund Custodians (PFC).

As already said, PENCOM is the agency responsible for regulating, supervising, and ensuring the efficient administration of Pension affairs in Nigeria.

Pension Fund Administrators perform the following specific duties:

- Establishing a Retirement Savings Account (RSA) for every employee with a Personal Identity Number (PIN).
- Investing and administering Pension Fund assets and funds in compliance with the Pension Act.
- Keeping records of all transactions pertaining to the Pension Fund they oversee.
- Supplying the PENCOM and workers of the RSA's beneficiary with regular updates on investment plan market returns and other performance metrics.

Closed Pension Fund Administrators: The 2004 Act mandates any private or public agency (that wishes to manage its fund) to be licensed as CPFA, provided they have a well-managed and self-funded pension system. The CPFA shall have the same duties and tasks as the PFA, and shall report to PENCOM.

Pension Fund Custodians were introduced in response to poor managerial decisions and the failure to maximize prior Pension Fund Schemes. The Act divided the administration of the Pension Fund and its assets from their real custody and security. The obligations of the PFC are:

- Receiving the total contributions sent by an employer on behalf of the beneficiaries of RSA.
- Holding pension funds and assets in safekeeping on behalf of PFA for the employees and beneficiaries of RSA.
- Settlement of transactions and administration of pension fund investment-related operations.

[6] Closed Pension Fund Administrators | National Pension Commission (pencom.gov.ng)

### 2.3.3 Contributory pension scheme

The 2004 Act represents a radical departure from the previous Direct Benefits (DB) pension system in Nigeria. This program is characterized as contributory and completely funded. The new Contributory Pension Fund offers individual Retirement Savings Accounts (RSA) to employees (Ajibade, et al., 2018). Nigeria's private and governmental sector employees are covered by the Contributory Pension Fund, which was established in 2004. The minimum individual contribution is 8% of monthly pay, and the minimum employer contribution is 10% of each employee's monthly compensation (Nageri, Adekunle, & Muritala, 2019). Public and private sector employees are eligible to make contributions to their retirement savings accounts under the program. Additionally, companies must have group life insurance coverage equal to at least three times the yearly salary of each employee.

To ensure that retirees receive their gratuities and pensions on time and on a regular basis, the Contributory Pension Scheme was implemented in Nigeria in 2004 as part of the pension law reform. Other goals of the scheme include granting employees the right to make a choice of the licensed Pension Fund Administrator to administer gratuities and pensions, and establishing uniform rules, regulations, and standards for the administration and payment of retirement benefits for public and private sector employees in the pension industry (Nageri, et al., 2019).

## 2.4 The Nigerian Pension Reform Act (2014)

PENCOM enacted the Pension Reform Act (2014), as the most current legislation. This Act nullifies the Pension Reform Act No.2 of 2004. It authorizes the Pension Reform and has a total number of one hundred and twenty-one (121) sections with fifteen (15) parts[7]. Its goals include:

[7] 1448643400_PRA_2014.pdf (pencom.gov.ng)

- Establishing a unified set of rules, regulations, and standards for the management and dispense of retirement benefits for the federal government, the state government, the local government councils, and the private sector.

- Making provision for the efficient operation of the contributory pension system.

- Ensuring that each individual who has worked in either the public or private sector receives his/her retirement benefits at the right time.

- Assisting free-spending workers by ensuring that they save enough to provide for themselves in old life

According to Sunday & Ehiogu (2014), the confidence of workers in the 2004 Pension Reform Act was dampened with the numerous cases of fraud experienced. This, among other factors, prompted the need to address the loopholes in the Act, and hence resulted in the establishment of the Pension Reform Act 2014. The new Act adopted a more stringent penalty and sanction for law breakers, expanded the contributory pension scheme participation scope and much more. Some of the major highlights of the Pension Reform Act 2014 in comparison to the Pension Reform Act 2004 includes:

- Increase in the pension contribution rate: The defunct Pension Reform Act 2004 requires a contribution rate of 7.5% from both the employee and their respective employer from their monthly emoluments, however this rate was increased to 12% for the employer and 8% for the employee. The new Act also enforces a 20% contribution on employers, who bear the total pension contribution for their employees.
- Private sector employers' participation scope was decreased in the Pension Reform Act 2014 from five employees to three employees so as to increase participation rate and include employees in small scale enterprise in the contributory benefit scheme.
- In relation to sanctions and penalties: The Pension Reform Act 2014 does not only grant PENCOM the power to revoke the license of non-compliant operators but also the ability to take proactive corrective measures on licensed operators if their actions could jeopardize the safety of the pension asset. In addition, the new Act now empowers PENCOM to initiate a criminal proceeding against employers that frequently default in remitting employees' pension contribution. Furthermore, new offences are created to cater for the more sophisticated mode of pension asset illegal diversions

and more severe penalties of not less than ten years imprisonment and/or fine of three times the amount mismanaged or diverted.

- The securities in which pension funds can be invested into was expanded to include specialist investment funds and other financial instruments, subject to the approval of PENCOM.

### 2.5 Principal obstacles of Nigeria's contributory pension scheme

Among others, the difficulties faced by pension schemes in Nigeria include;

- **Low Rate of Adoption of the Contributory Pension Scheme (CPS):** This is one of the challenges Nigeria's pension systems face. The coverage of the CPS is one of the key issues the Nigerian pension market is currently has, as it develops. There were 9.5 million owners of Retirement Savings Accounts (RSAs) as of December 2021 (PENCOM, 2022) and this is a low number of contributors compared to the working population of 64,479,317 (The World Bank , 2022).

- **Lack of investment products:** Despite the availability of pension funds, there is a lack of investment products (especially those that adhere to tight requirements). This results in low activity. The lack of local skills to arrange and manage infrastructure funds within an acceptable risk profile is the cause of this (Vanguard Newspaper, 2015). Consequently, pension fund contributions are not invested. This will result in a reduction in seniors' income.

- **Inadequate technological capacity:** Some key projects, such as the transfer of RSAs between PFAs, are not possible because there is insufficient technological capacity to guarantee the integrity of the Pension contributions database (Ime, 2018).

- **Insufficient knowledge and skills:** Pension Fund Administrators find it challenging to conduct analysis on specific investments, such as infrastructure projects, because they lack the necessary knowledge and expertise (Ogbu, 2012).

- **Compliance level:** Due to the absence of a complete database of employers in the country, private sector compliance has remained a significant obstacle. This limits the scope of the regulator's enforcement (BGL, 2010). In addition, employers are unwilling to comply with the provisions of the Act since it is perceived as an additional expense for their businesses. Similarly, integrating the informal sector into the new plan has become challenging, possibly because the informal sector in Nigeria does not have an organized structure and has a clumsy composition. According to BGL (2010), a lack of trust on both sides has made it challenging to build goods for the informal sector, which is dominated by sole proprietorships and small and medium-sized enterprises. The operators think the donations from the unorganized sector won't be consistent, while the unorganized sector thinks they can manage their money more effectively.

- **Remittance deductions:** It may be challenging for businesses, employers, and employees to remit benefits to the Retirement Savings Account (RSA). It is important to increase pension contributions whenever salaries increase. Doing this will improve portfolio assets of pension funds in Nigeria (Adesina, 2006). According to a National Pension Commission (PENCOM) (2019) publication in Pension Nigeria, the majority of states in the federation have failed to completely implement the Contributory Pension Scheme, with the exception of the Federal Capital Territory and six others. Therefore, compliance with employer and employee pension contributions, payment of rights accrued, and implementation of the Group Life Insurance Policy has been low.

## 2.6 Financial performance of pension funds

According to Cheong (2007), a company's Financial Performance is a subjective indicator of its success. Financial performance of pension funds can be enhanced by generating profit from assets and financial reports provide valuable information regarding the performance of pension systems to interested stakeholders, such as employees and retirees (Brady, 2009). Indeed, financial performance is essential for estimating net income and evaluating a company's financial risk. Moreover, the financial welfare of retirees can be affected by the financial status of the pension scheme that pays their benefits during retirement years.

Through the utilization of a variety of accounting and mathematical methodologies, financial performance is determined by evaluating how effectively a company uses its resources to generate profit (Verma, 2022). Organizations prioritize financial performance because it is essential for assessing the current financial health and stability of a company, as well as for achieving high performance standards and continuous future growth. In the context of Pension Funds, Van Horne & Wachowicz (2010) define the performance of a pension fund as the return on investment of members' contributions. In other words, when Pension Funds have been pooled and saved from private and public contributors, the budgeting, control, capital investment decisions, planning, and ratio analysis of these pension funds denotes financial management.

A benchmark or technique is put in place in order to ascertain if pension funds have experienced profit or loss. This, consequently, denotes the financial performance of pension fund administrators.

The importance of ratios in determining the financial performance of pension funds, although important, cannot be overstated because more detailed information is very often useful (DNB, 2022). Gallagher & Martin (2009) describe ratios as the relationship between two financial balances or calculations. Examples of these include Liquidity, Leverage Asset Management, Profitability, and Market Value ratios. However, Pension Fund performance varies from one pension fund administrator to another. Superior financial performance can be attributed to the actions of a highly skilled investment manager who has invested the funds and has yielded profit. On the contrary, the inferior performance of the fund may be characterized by a manager whose investment decisions yield a loss.

## 2.7 Theoretical review

In this section we approach three theoretical frameworks related to our study: the theory of intermediation, the participation cost theory, and the life-cycle theory are examined in turns.

### 2.7.1 Theory of financial intermediation

The financial intermediation theory is founded on the theories of informational asymmetry and agency. According to Kigen (2016), it can be traced back to the work of Gurley and Shaw in the 1960s. In principle, the theory states that institutions aim to reduce costs (information and transaction) that arise from information asymmetry between borrowers and lenders. In a financial context, "financial intermediary" refers to an individual, institution, or company that mediates between two or more entities, including pension fund administrators (Allen & Santomero, 1998).

Pension funds receive large flows of savings because many beneficiaries regard them highly. The expansion of the financial intermediation theory to the activities of Pension Fund Administrators results from Davis (2000), who recognizes pension funds as institutional investors that gather, save, and invest money contributed by beneficiaries and sponsors, in order to provide for the beneficiaries' future pension entitlements.

PFAs may not generate liquid liabilities, but according to advocates of the theory of intermediation, they have a significant impact on how security markets are structured, which boosts the effectiveness of the financial markets (Ajibade, et al., 2018). The theory stresses that pension funds can effectively intermediate between the financial sector and the economy to stimulate growth. PFAs facilitate growth by investing accumulated funds in diverse financial assets such as real estate, government bonds, deposits, corporate stocks, foreign instruments, and corporate debt. Thus, the theory of financial intermediation will contribute to the study by illuminating the role of contribution density in Pension Funds' financial performance in Nigeria.

### 2.7.2 Participation cost theory

Traditional frictionless theories suggest that intermediaries do not provide value and that there is no need for intermediaries to manage risk, if all investors are active and participate in the market (Nageri, et al., 2019). There is substantial evidence that the assumption of absolute participation does not hold true in practice (Allen & Santomero, 1998). The average household holds few equities and participates in only a few financial markets. There is limited market participation as opposed to total engagement (Nageri, et al., 2019).

Thus, a theory of intermediation based on participation costs is consistent with the reality that intermediaries trade risk and engage in extensive risk management. Mutual funds and pension fund administrators try to optimize participation costs, so they invest efficiently on behalf of customers who possess high cost of direct participation. By developing products with reliable cash flow distributions, they can reduce their customers' participation costs. Without friction, a household should always evaluate and change its portfolios by the information available (Nageri, et al., 2019).

### 2.7.3 Life-cycle theory

The life-cycle model predicts that individuals will work and accumulate assets while young and middle-aged. These individuals retire and draw down assets when old (Hayes, 2021). Pension funds go through various stages of development. They include the start-up phase, the growth phase, and the maturity phase, which are described under the life cycle theory of retirement (Iwegbu, 2020). These phases describe the process of growth that pension administrators follow. The administrators of pension experience difficulty in raising money at the start-up stage. Pension funds expand at the growth phase because there is already a sizable pool of money that can be invested in a variety of economic sectors (Farayibi, 2016). The administrators of pension funds perform at their best during the mature stage, which is the stage where the assets will be passed down to the retirees when they are old.

### 2.7.4 Competitive model theory

The competitive model theory assumes that contributors are capable of identifying the variables which will affect the ability of the schemes to make pension payments. Therefore, they assess the pension funds' investment performance concerning these variables, and make decisions which maximize results in light of their unique situations. In reality, the typical contributor does not have easy access to or understanding of these factors. When information is provided, it is frequently sparse or serves as a stand-in for the important variables. Also, when adequate information is provided, it is often difficult for most members to understand (Hinz, Rudolph, Antolin, & Yermo, 2010).

### 2.7.5 Traditional approach

Short rates of return have received so much attention in the traditional method of measuring the performance of pension plans (Hinz, et al., 2010). Records of monthly or annual pension returns that are not assessed against a benchmark or target are not fully meaningful because the aim of the second pillar scheme is to guarantee enough retirement income to individuals (Hinz, et al., 2010).

International returns comparisons or other performance metrics like the Sharpe ratios may not be entirely meaningful whenever investors are presented with a variety of options. Some decision-makers may place less emphasis on performance evaluation, based on their assumption that demand will determine the best allocation of assets (Hinz, et al., 2010). Additionally, some governments implicitly believe that competition in open defined contribution pension systems optimizes individual pensions. Individuals will select pension funds administrators that optimize their risk-reward choices, and pension fund administrators will fight for assets and contributions (Hinz, et al., 2010).

## 2.8 Empirical review

Using panel data and multiple regression analysis, Ajibade, et al. (2018) assessed the relationship between the financial performance and some features of pension funds in Nigeria, and discovered that there is statistically substantial evidence for the relationship between features such as contribution density, age of fund and idle contribution and pension financial performance. (Oluoch, 2013) also made use of regression analysis to ascertain the relationship between performance of pension fund, measured using return on assets, and fund value, life expectancy age, and pension contribution in Kenya. The outcome suggests that there is a high positive relation between life expectancy, age, and pension fund financial performance, while pension fund net asset and pension contribution have less effect on performance. Kigen (2016) also employed fixed effects regression model to examine the effect of cumulative pension asset, density of contribution, retirement age, cost and membership size on pension fund financial performance, measured as recorded fund income. The study result indicates that costs, pension contribution and cumulative fund asset are the variables that have significant effects on pension fund financial performance in Kenya.

Antolin (2008) examined on a risk-adjusted basis the aggregate investment performance of privately managed pension funds, by country, using relatively common investment performance indicators, such as the Sharpe ratio, and attribution analysis against portfolios benchmark by adopting ex-post Markowitz portfolio. His results show that pension funds have generally underperformed in comparison to the evaluated portfolio.

Iwegbu (2020) used autoregressive distributed lag (ARDL) to examine the pension fund, financial development, and production growth in Nigeria, and discovered that pension fund contributions are successful in promoting growth through investments in portfolios that produce short term returns. The report advises the Pension Fund Administrators to invest in short-term return portfolios and unbundle significant amounts of money held in government securities to invest in other short-term return portfolios (Iwegbu, 2020).

The results of Nageri, et al. (2019) investigation of the capital market capital development and pension funds development in Nigeria, utilizing the ARDL bound testing procedure, found a long-term co-integrated relationship. Their findings also show a short-term causal link between pension fund assets and the stock market. Ololade, Adegboye, & Salawu (2019) use data derived from annual reports of particular pension fund administrators, as well as information from the archives of the National Pension Commission. In addition, they use maximum likelihood analysis to study contributory pension fund administrators in Nigeria. The findings show that the chosen fund administrators are inefficient as a result of high input costs for personnel, property, and equipment.

# CHAPTER 3

# METHODOLOGY

## 3.1 Description of research methodology

This study utilized an Ex-Post Facto research design, as it uses already established variables in determining what influences the financial performance of pension funds. Twenty (20) Nigerian pension fund administrators make up the study population and a 5-year study time frame from 2016 to 2020 was used. The limited time frame used is as a result of the inconsistency in the style of yearly report presentation by both the Pension Fund Administrators and National Pension Commission, making it difficult to aggregate all selected variables values and the non-availability of financial statement reports for all Pension Fund Administrators. The study relied on quantitative secondary data collected from Pension Fund Administrators individual financial statements as well as PENCOM annual reports.

PFAs published financial statements and PENCOM annual reports was analyzed and data extracted for retirement savings account membership, expenditure, contribution density, age of fund, idle contribution and fund size, according to our objectives and related questions. This research applied a multiple regression model using the R Project for Statistical Computing, specifically R version 3.5.1 and the lessR package to objectively assess the pension fund characteristics that affect the financial performance of pension funds in Nigeria.

Following the availability of limited data for analysis, this study applies several models using the various variables defined earlier, before selecting a more suitable model. The details of these models can be found in Chapter 4.

Pension fund characteristics selected in evaluating the financial performance of Pension Fund Administrators, includes age of fund, fund size, contributions, expenditure, total number of registered retirement savings accounts, and idle fund. Each of this variables are detailed below:

### 3.1.1 Retirement savings account membership

The retirement savings account membership is linked to private and public Retirement Savings Account (RSA) registrations. For over a decade, the total RSA registration has experienced increased participation, due to the compliance efforts of PENCOM and the marketing strategies of the PFAs. This has invariably increased the contribution of Pension Funds that will be invested. This variable has been considered by Kigen (2016) in his research and this author suggests that it is has no significant relationship with the performance of pension funds.

We can then set our first question, to which we will try to find an answer in the next chapters, and corresponds to the first objective stated for this work (cf. Section 1.2).

**Q1:** Has the retirement savings account membership no significant effect on the financial performance of pension funds in Nigeria?

### 3.1.2 Expenditure of pension fund

The term "expenditure of pension fund" refers to spending associated with the management and administration of the fund. Professional valuation fees, custodial fees, trustee fees, investment management fees, costs of records retention, benefit calculations, member communications, legal or consulting fees, costs of adhering to governance regulations, bank fees, audit fees, and other professional costs approved by the National Pension Commission are a few of the expenses that may specifically accrue to the fund. (PenCom, 2018). Kigen (2016) analyzed the effect of administrative and investment costs on the performance of pension funds in Kenya in his study, this is contrary to the work of Ajibade, et al. (2018) where it was established that this variable has no significant effect. According to Tijjani (2014), Pension Fund Administrators must make sure that their income always exceeds their expenses to retain strong financial standing throughout time.

Question 2 follows.

**Q2**: Has expenditure of pension fund no significant effect on the financial performance of pension funds in Nigeria?

### 3.1.3 Density of contributions

Another major determinant of pension funds' financial performance as stated by Kigen (2016) is the rate of contributions received by Pension Fund Administrators. Oluoch (2013) also noted that the contribution density is a crucial aspect that influences pension benefits. According to the Pension Reform Act of 2014, the new employee and employer contributions are 8% and 10%, respectively. Large contributions bring economies of scale to the PFA. In Kigen (2016) research study it was established that the contribution has a positive significant regression coefficient in predicting the financial performance of pension funds, this result however contradicts the outcome of Ajibade, et al. (2018) research study that suggests that contribution has a significant negative effect on financial performance and Oluoch (2013) study which suggest that the variable contribution is not a significant factor.

**Q3**: Has the density of contribution no significant effect on the financial performance of pension funds in Nigeria?

### 3.1.4 Age of fund

This refers is how long the fund has existed, in this case, the age of the pension fund and the age of the Pension Fund Administrator are the same. Pension Fund are expected to be more profitable as their existence grow. In his research, Tijjani (2014) found that a pension fund administrator's financial sustainability is projected to increase with age. In their work, Ajibade, et al. (2018) established that the age of fund has a significant positive effect on financial performance, which is measured by the Unit Price, computed dividing the net assets value of the pension fund by the number of units it holds. They went further to conclude that pension funds perform better financially as they mature.

**Q4**: The age of fund has no significant effect on the financial performance of pension funds in Nigeria?

### 3.1.5 Idle contribution

Idle contribution relates to the contributions made to the scheme that are not invested, that is, they earn no interest or other form of investment income. While it is important to ensure that optimal cash is available for liquidity needs, such as meeting obligations to retirees, having huge amount of idle fund may not be considered a good investment strategy. Ajibade, et al. (2018) proved that idle contribution has a significant positive effect on the financial performance of pension fund.

**Q5**: Has the idle contribution no significant effect on the financial performance of pension funds in Nigeria?

### 3.1.6 Fund size

For this research, the variable fund size is expressed by the Net Pension Asset Under Management. According to Gallagher & Martin (2009), a pension fund's performance improves as it grows in size. The outcome of Kigen (2016) shows that fund size has a negative and significant relation with the financial performance of pension funds, while the result of Oluoch (2013) shows that there is no significant relationship between the amount of assets and the financial performance of the pension funds.

**Q6**: Has the fund size no significant effect on the financial performance of pension funds in Nigeria?

### 3.2 Model specification

The research model in general terms is stated as $Y = f(x)$ . According to Section 3.1, eight variables were used, namely: Investment income, Profit before tax, Retirement savings account membership, Fund Size, Expenditure, Age of fund, Density of contribution, and Idle fund. In fact, three variables were interchangeably used as the dependent variable, that is, as the measure of the financial performance of pension funds, and they include Investment Income, Fund Size and Profit before tax. The following works were referenced in the course of the analysis: Oluoch (2013); Kigen (2016); Ajibade, et al. (2018), and Adekoya, Nwaobia, & Siyanbola (2022).

After a number of attempts (details are in Chapter 4), we came to the conclusion that the variables to include in the model should be Profit before tax of PFA, Density of contribution, Idle contribution, and Age of fund. Then, the following regression model will be used to achieve the objective of this study:

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \epsilon_i$$

where:

$i = represents\ an\ individual\ PFA\ \ for\ a\ particular\ year.$

$Y_i = Profit\ before\ tax\ of\ PFAs$

$\alpha = Constant\ Term$

$\beta_1, \beta_2, and\ \beta_3\ are\ regression\ coefficients$

$X_{1i} = Pension\ Fund\ Contribution\ by\ PFAs$

$X_{2i} = Idle\ contribution\ of\ PFAs$

$X_{3i} = Age\ of\ Fund\ of\ PFAs$

$\varepsilon = Error\ Terms$

# CHAPTER 4

# RESULTS AND DISCUSSIONS

## 4.1 Introduction

This chapter entails presentation of data and test of hypotheses using the linear regression analysis techniques in R. As already mentioned, before arriving at the more suitable model described in Model Specification section of Chapter 3, Section 3.2, several other models were attempted to test suitability in relation to using linear regression, because of the need to satisfy the linear regression assumptions. Hence, Section 4.2 briefly describes these attempts, while 4.3 includes description of the final model adopted. Details of the results can be found in the following html link: https: MFW_Oct_22/ThesisAnalysis [8]. This link was necessary due to the volume of graphics and other generated details of the analysis, which would make the document less readable and incoherent. A summary of the essential contents is in the Appendix at the end of this text.

## 4.2 Model trials

This section entails a summary of the different models attempted and their corresponding details and chart can be found in the Link provided in section 4.1 above.

### 4.2.1 Initial trial models

These models are based on aggregated figures for all PFAs recorded in the PENCOM annual report, and a 10-year observation was used due to dearth of data and the inconsistency of report presentation. This approach is similar to that employed in the study of Oluoch (2013). The table below shows variables used in these trails;

[8] https: MFW_Oct_22/ThesisAnalysis

*Table 1:* ***Description of variables employed in the initial trials***

| S/N | CATEGORY OF VARIABLES | VARIABLES | INDICATORS | SOURCE |
|---|---|---|---|---|
| 1 | Dependent /Independent variable | Financial Performance | Investment income (Inv.Inc) | PENCOM annual reports. |
| 2 | Dependent /Independent variable | Fund Size | Net Pension Asset Under Management (AUM) | PENCOM annual reports. |
| 3 | Independent variable | Density of contribution | Amount of pension contribution recorded over the year. (DC) | PENCOM annual reports. |
| 4 | Independent variable | Retirement Savings Account Membership | No of registered retirement savings accounts (RSAM) | PENCOM annual reports. |
| 5 | Independent variable | Expenditure | Asset based Fees and Vat (EXPF) | PENCOM annual reports. |

*Notes: The Age of Fund and Idle fund was not considered in the initial trials. The reason being that, the data used in these trials are aggregated figures of all PFAs for each observation, therefore except the study employs an average figure for all PFAs in each year of observation which will be misleading this will be impossible to use. In the case of Idle Fund, this variable was not available for all PFAs in each year, either due to non-disclosure or change in the style of financial statement presentation and therefore would lead to significant inconsistency when compared to other available variables.*

Models version 1 (a) and b)):

$$a)\ Inv.Inc = \alpha + \beta_1\ DC1 + \beta_2\ EXPF1 + \beta_3\ RSAM1 + \epsilon_i\ ;$$

Where the dependent variable is measured as investment income, derived as an aggregate of Interest/Coupons, Dividends and Net Unrealized Gains/(Losses) on quoted equities / equity funds for all PFA during each year; and independent variables includes EXPF, DC, and RSAM, derived as relative values, that is the values recorded during each year.

Result Summary: The outcome shows that the regression model is statistically significant with a probability of F-Stat at 0.0001. However, for the explanatory variables, only EXPF appears to have significant impact on the Investment income, DC and RSAM have no significant effect on this variable.

The result shows a scanty scatter plot due to the limited observation used, relating to the limited data available. The scatter plot line is nonlinear, there is a high correlation between DC1 and EXPF1 at 0.81. Also the result of Breusch Pagan (bptest) indicates the presence of heteroscedasticity. Hence the model violates basic regression assumptions. Therefore, a log transformation was applied in the next model (b) below:

b) $logInv.Inc1 = \alpha + \beta_1 \, logDC1 + \beta_2 \, logEXPF1 + \beta_3 \, RSAM1 + \epsilon_i$

The log transformation was applied to the variables Inv.Inc, DC and EXPF

Result Summary: As in model a) above, only the EXPF pension fund feature appears to be significant and the regression model is significant with probability of F-Stat of 0.000.

Similar challenges as in a) were experienced, the line across the scatter plot is nonlinear, shows serial correlation of residuals, and heteroscedasticity is present.

Following these challenges, the dependent variable was changed to represent the Fund size, which is the Net Pension Asset Under Management (AUM) and independent variables includes EXPF, DC, and RSAM, derived as relative values, that is, the values recorded during each year.

Models version 2 (c) and d)):

The version 2 models applied a log transformation:

c) $AUM2 = \alpha + \beta_1 \, DC2 + \beta_2 \, EXPF2 + \beta_3 \, RSAM2 + \epsilon_i$

d) $logAUM2 = \alpha + \beta_1 \, logDC2 + \beta_2 \, logEXPF2 + \beta_3 \, RSAM2 + \epsilon_i$

Result Summary: Both models indicate a significant regression model as the probability of F-Statistic was 0.000. Again, only the independent variable EXPF appear to have a significant relationship to financial performance of pension fund measured in model (c) as AUM and in model (d) as log AUM.

Both models had result which violates regression assumptions. A curvier scatter plot line, serially correlated residuals, residual plot that is different from a normal distribution, and *bptest (R function for Breusch–Pagan test)* that confirms the presence of heteroscedasticity.

In an effort to further identify a better model, the data were re-examined and the following changes were made: Investment income (Inv.Inc) and Fund Size (AUM) were alternated as a measure of dependent variable; and independent variables AUM, EXPF, DC, and RSAM, were extracted as Cumulative values, that is the values recorded from inception to each year. This led to the following new models version:

Models version 3 (e) and f)):

e) $Inv.Inc3 = \alpha + \beta_1 AUM3 + \beta_2 DC3 + \beta_3 EXPF3 + \beta_4 RSAM3 + \epsilon_i$

Result Summary: At 5% level of significance none of the explanatory variables appears to have a significant relationship with Investment income.

The scatter plot line had an exponential growth close to the midpoint upward and a curvy shape at inception, also there was a perfect correlation between AUM and DC, likewise the correlation between DC and EXPF was very high at 0.98 and 0.97 for EXPF and RSAM. Signifying multi-collinearity. There is model also show a non-constant variance of error term.

f) $logInv.Inc3 = \alpha + \beta_1 logDC3 + \beta_2 logEXPF3 + \beta_3 RSAM3 + \epsilon_i$

Result Summary: DC, EXPF and RSAM do not have significant influence over Investment income.

This model was close to being linear, but high ffmulti-collinearity issue persists among all independent variables, suggesting a simple linear regression.

### 4.2.2 Second trial models

In order to have a significant number of observations and having referenced studies such as that of Ajibade, et al. (2018); and Adekoya, et al. (2022), this study went back to the drawing board to research on the available pension fund characteristics that could be extracted for each PFA, and employed a different data collection process of extracting the variables figures per PFA. The process was also met with the issue of dearth of data and the inconsistency of report presentation style.

This process was applied in extracting the following variables for the following attempted model versions:

*Table 2:* ***Description of variables employed in the second trials***

| S/N | CATEGORY OF VARIABLES | VARIABLES | INDICATORS | SOURCE |
|---|---|---|---|---|
| 1 | Dependent /Independent variable | Financial Performance | Investment income or gross Income (INC) | PFA Financial Statements and PENCOM annual reports. |
| 2 | Dependent /Independent variable | Financial Performance | Profit before tax (PBT) | PFA Financial Statements and PENCOM annual reports. |
| 3 | Dependent /Independent variable | Fund Size | Net Pension Asset Under Management (AUM) | PENCOM annual reports. |

| | | | | |
|---|---|---|---|---|
| 4 | Independent variable | Density of contribution | Amount of pension contribution recorded over the year. (DC) | PENCOM annual reports. |
| 5 | Independent variable | Retirement Savings Account Membership | No of registered retirement savings accounts (RSAM) | PENCOM annual reports. |
| 6 | Independent variable | Idle Fund | Cash and cash equivalent and bank balance (Idle) | PFA Financial Statements and PENCOM annual reports. |
| 7 | Independent variable | Age of Fund | No of years since commencement of operation by the PFAs (AOF) | PFA Financial Statements and website. |

Models Version 1* (a)):

General model equation is as follows: $Y_{it} = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \epsilon_i$

a) $INC = \alpha + \beta_1 AUM + \beta_2 DC + \beta_3 Idle + \beta_4 AOF + \beta_5 RSAM + \epsilon_i$

Result Summary: The overall model was significant with F-statistic of 793.833 and related p-value of 0.000, also the individual regression coefficients AUM and Idle were significant while DC, AOF and RSAM are not significant in measuring financial performance of pension funds.

There was evidence of heteroscedasticity on the scatter plot visual and the line plot is not entirely linear. Also high multi collinearity exist between DC and Idle and a perfect correlation between AUM and DC. Therefore, to address the issue of high correlation between the independent variables gave rise to next models version.

Models Version 2* (b), c), d) and e)):

b) $INC = \alpha + \beta_1 Idle + \beta_2 AOF + \beta_3 RSAM + \epsilon_i$

Result Summary: The overall model was significant with F-stat of 185.770 and related p-value of 0.000, also of the individual regression coefficients only RSAM has significant relationship with financial performance of pension funds measured as Income.

While multi-collinearity issue was addressed with this parsimonious model, the linearity assumption and Homoscedasticity are violated. Hence, the search for a more suitable model continues with the following model where the dependent variable is measured as Profit before tax instead of Income.

c) $PBT = \alpha + \beta_1 \ Idle + \beta_2 \ AOF + \beta_3 \ RSAM + \epsilon_i$

Result Summary: The overall model was significant with F-stat of 123.662 and related p-value of 0.000, also of the individual regression coefficients only RSAM has significant relationship with financial performance of pension fund measured as Income.

Similar to b) above, Multi-collinearity was addressed but the linearity assumption and Homoscedasticity assumption are violated. Hence, the further attempts were made.

The following other similar models were test and they also fail to meet the Homoscedasticity assumption criterion in particular:

d) $PBT = \alpha + \beta_1 \ DC + \beta_2 \ Idle + \beta_3 \ AOF + \beta_4 \ RSAM + \epsilon_i$; with the inclusion of independent variable DC. Here only the independent variable DC was significant in influencing the financial performance of pension funds. But also has a high correlation with the Idle independent variable at 0.80.

e) $PBT = \alpha + \beta_1 \ DC + \beta_2 \ Idle + \beta_3 \ AOF + \epsilon_i$; with the exclusion of independent variable RSAM. This model has similar result as in model d).

Models Version 3 (f), g), h) and i)):

Here we focused on the log transformation of the previous models so as to have a better useful model.

f) $logPBT = \alpha + \beta_1 \ logDC + \beta_2 \ logIdle + \beta_3 \ AOF + \epsilon_i$

Result Summary: Until now, our models have in one way or the other violated the linear regression assumptions, however this model satisfy most of these assumptions, it appears to be of good fit for our data with an adjusted R-squared at 80% and the overall model is significant with F-statistics of 125.159 and related probability of F-statistics of 0.000, also of the individual regression coefficients only DC has significant relationship with financial performance measured as Income with an associated p-value of 0.000.

Before relying on this model, the study further considered the following log transformed models:

g) $PBT = \alpha + \beta_1 \ logDC + \beta_2 \ logIdle + \beta_3 \ AOF + \epsilon_i$

Result Summary: Independent variables DC and Idle have a positive significant relationship with financial performance of pension funds, while the AOF has no significant effect.

While the overall model is significant at F stat, p-value of 0.000, the scatter plot clearly shows that the residuals are strongly serially correlated.

h) $logInc = \alpha + \beta_1 \ logDC + \beta_2 \ logIdle + \beta_3 \ AOF + \epsilon_i$

Here we interchange the dependent variable for Income (Inc) as opposed to Profit before tax seen earlier.

Result Summary:

As in the precedent model, independent variables DC and Idle have a positive significant relationship with financial performance of pension funds, while the AOF has no significant effect.

There is homoscedasticity, and the line across the scatter plot is curvy and therefore nonlinear.

i) $Inc = \alpha + \beta_1 \ logDC + \beta_2 \ logIdle + \beta_3 \ AOF + \epsilon_i$

Again, as in g) and h), Independent variables DC and Idle have a positive significant relationship with financial performance of pension funds, while the AOF has no significant effect. However, the model shows that residuals are serially correlated and also violates the linearity assumption.

### 4.3 Selected Model

The most useful model selected was from the second trial models (model f) of Models Version 3, as this is a parsimonious model and has a satisfactory compliance with linear regression assumptions.

The specific variables are redefined as follows:

*Table 3:* ***Description of variables employed in the selected model***

| S/N | CATEGORY OF VARIABLES | VARIABLES | INDICATORS | SOURCE |
|---|---|---|---|---|
| 1 | Dependent variable | Financial Performance | Profit before tax (PBT) | PFA Financial Statements and PENCOM annual reports. |
| 2 | Independent variable | Density of contribution | Amount of pension contribution recorded over the year. (DC) | PENCOM annual reports. |
| 3 | Independent variable | Idle Fund | Cash and cash equivalent and bank balance (Idle) | PENCOM annual reports. |

| | | | | |
|---|---|---|---|---|
| 4 | Independent variable | Age of Fund | No of years since commencement of operation by the PFAs (AOF) | PFA Financial Statements and website. |

```
##   BACKGROUND
##
## Data Frame:  lg
##
## Response Variable: logPBT
## Predictor Variable 1: logDC
## Predictor Variable 2: logIdle
## Predictor Variable 3: AOF
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  90
##
##
##   BASIC ANALYSIS
##
##                Estimate    Std Err  t-value  p-value    Lower 95%   Upper 95%
## (Intercept) -11.084848   1.656281   -6.693    0.000   -14.377426   -7.792270
##       logDC   1.161023   0.076361   15.204    0.000     1.009222    1.312823
##     logIdle   0.105185   0.071201    1.477    0.143    -0.036358    0.246727
##         AOF  -0.019244   0.031825   -0.605    0.547    -0.082510    0.044022
##
## Standard deviation of logPBT: 1.752760
##
## Standard deviation of residuals:  0.769738 for 86 degrees of freedom
## 95% range of residual variation:  3.060378 = 2 * (1.988 * 0.769738)
##
## R-squared:  0.814    Adjusted R-squared:  0.807    PRESS R-squared:  0.797
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 125.159     df: 3 and 86     p-value:  0.000
##
```

*Figure 1:* ***Snapshot of results from the selected model***

**Model equation:**

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \epsilon_i$$

$$PBT = -11.084848 + 1.161023\, logDC + 0.105185\, logIdle - 0.019244\, AOF + \epsilon_{it}$$

**Interpretation of the Regression Analysis Result**

**Regression Coefficient**

Estimated Coefficient value for each of the independent variables shows that DC (Density of Contribution) have significant positive effect on FPPF (Financial Performance of pension administrators), as the coefficient value is 1.161023, while p-values is less than the 0.05. This denotes that a unit increase in DC led to increase in FPPF by 1.161023 units. The result also showed that Idle contribution and AOF are not significant variables.

**Coefficient of Multiple Determinations**

The result output shows an adjusted R-squared of about 80%, indicating that about 80% of variations in income generated by the pension fund administrators can be attributed to the pension fund characteristics identified (that is the Density of contribution, Idle contribution and Age of fund) and the remaining variation are a result of other factors not included in the model. As evidenced, the overall regression model is statistically significant as indicated by probability of F-statistic at 0.000, as it is well below the 5% significant level chosen for this study.

**Degree of Relevance of the Independent variables**

The F-statistic value showing 125.159 reveals that the explanatory variables identified in the study have relevance on the dependent variable and they are statistically significant based on the Prob(F-statistic) showing 0.000.

**Test of Hypotheses**

This is conducted to determine the significance of each independent variable identified in the model on the dependent variable, at a 5% level.

**Hypothesis One**

**$Ho_1$:** There is no significant impact of the density of contribution on the financial performance of pension funds in Nigeria.

**Discussion/Decision**

From the regression result table, the *p-value* of DC is 0.000. Therefore, we reject the null hypothesis and accept the alternative hypothesis that the density of contribution has a significant effect on the financial performance of pension funds in Nigeria. Kigen (2016) and Adekoya, et al. (2022) research established that density of contribution has a positive significant regression coefficient in predicting the financial performance of pension funds. This research result, as well as Kigen (2016) and Adekoya, et al. (2022) research results, contradicts the outcome of Ajibade, et al. (2018) research that suggest that contribution has a significant negative effect on financial performance and Oluoch (2013) study which suggests that the pension contribution is not a significant factor.

**Hypothesis Two**

**$Ho_2$:** There is no significant impact of Idle fund on the financial performance of Nigerian pension funds.

**Decision**

From the regression result table, the *p-value* of DC is 0.147. Therefore, we do not reject the null hypothesis and conclude that Idle has no significant effect on the financial performance of Nigerian pension funds. Ajibade, et al. (2018) suggest in their study that idle contribution has a significant and positive effect on the financial Performance of pension fund.

**Hypothesis Three**

**Ho3:** There is no significant impact of fund age on the financial performance of pension funds in Nigeria.

**Decision**

From the regression result table, the *p-value* of AOF is 0.547. Therefore, we do not reject the null hypothesis and reject the alternative hypothesis that there is significant impact of fund age on the financial performance of Nigerian pension fund. In his research, Tijjani (2014) found that a pension fund administrator's financial sustainability is projected to increase with age. Ajibade, et al. (2018) established that Age of fund has a significant positive effect on financial performance measured by Unit Price. Similarly, Adekoya, et al. (2022) study also shows that Age of fund has a positive significant effect on financial performance of pension funds.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATION

## 5.1 Conclusion

From the results of the analysis carried out, the study concludes that the financial performance of the Pension Fund Administrators in Nigeria is increasing. It is revealed that Age of Fund and Idle Fund has no significant effect on financial performance of pension fund in Nigeria, compared to Density of contribution which have positive and significant impact on financial performance of pension fund in Nigeria.

More so, the study concluded that Density of contribution, Idle contribution and Age of fund explain for about 80% of the financial performance of pension funds in Nigeria, that is, these are the pension characteristics that Administrators should be more aware of, particularly the Density of Contribution. The above factors are considered important in assessing the performance of pension funds in Nigeria.

## 5.2 Recommendation

The following recommendations are proposed, based on the results and conclusions of the research:

- Pension contributions should be monitored more closely to ensure that they are employed in productive investments with controlled risk.
- Pension Fund Administrators should consider more carefully their past experiences and investment decisions, in making future effective investment decisions.
- Idle pension contribution sitting as cash or cash equivalent should be better managed. There should be a quest for a better balance between liquidity needs and loss of purchasing power due to rising

inflation and potential return, as these idle funds can be utilized to generate more income for the pension fund.

## 5.3 Limits of the study and further research

This study was limited by scope as it considered 5 years data time frame and not all PFAs yearly variables figures were available, perhaps an expanded coverage can be made in the future so as to have a more stable and reliable model to establish the major variables that impact the financial performance of pension funds.

In selecting the variables, both the dependent and independent variables are based on economic and financial reasoning, perhaps other approaches could be researched in selecting these variables.

In addition, Financial Performance can be measured using different variables such as Income, Profit before tax, Net Asset Value per unit etc. perhaps a research can be carried out on the most suitable one or establishing criteria in selecting the most suitable variable.

It was not straightforward arriving at a suitable model which satisfy the assumptions of a linear regression model, and therefore could raise question regarding the suitability of this model, hence a research adopting other models can be done for this study.

Lastly, a research based on varied performance of different pension funds could also be carried out.

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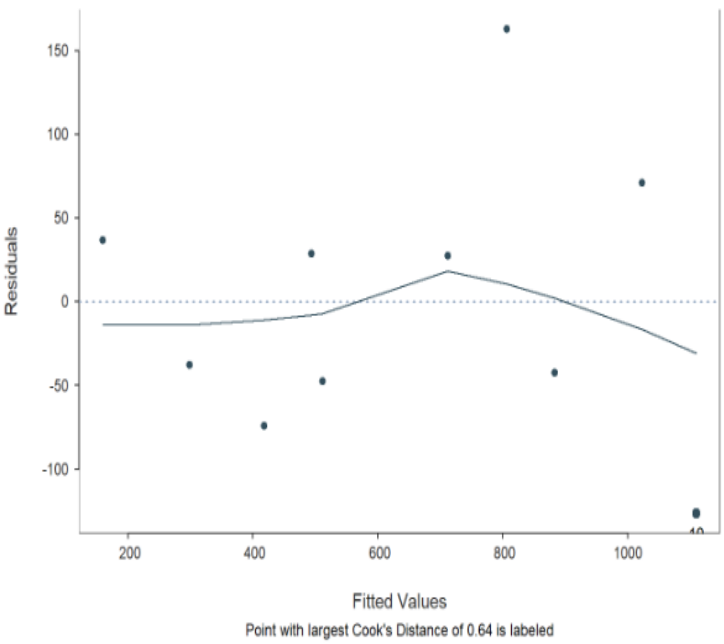
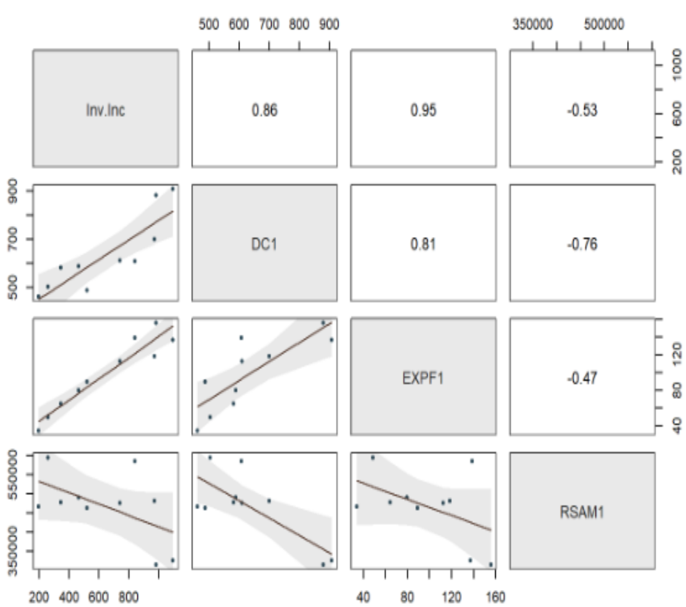
# APPENDIX

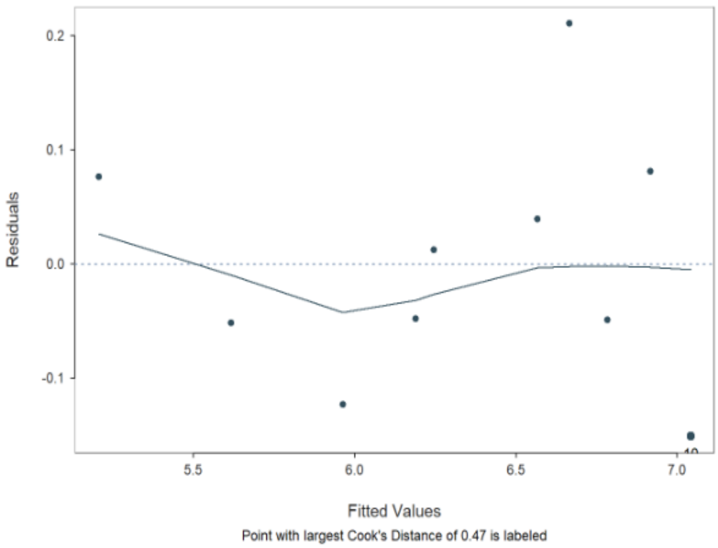
```
#Model version 1a.
ThesisData <-read.csv(file.choose(), header = T)
Regression(Inv.Inc ~ DC1 + EXPF1 + RSAM1,data= ThesisData)
```

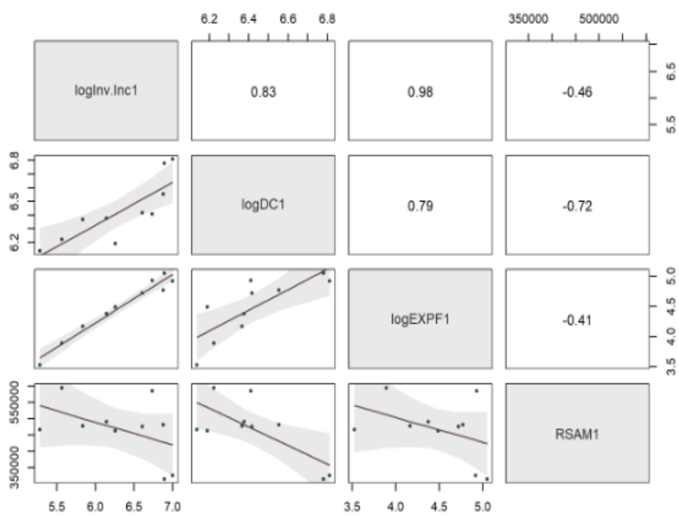



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=Inv.Inc ~ DC1 + EXPF1 + RSAM1, data=ThesisData, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData
##
## Response Variable: Inv.Inc
## Predictor Variable 1: DC1
## Predictor Variable 2: EXPF1
## Predictor Variable 3: RSAM1
##
## Number of cases (rows) of data:  10
## Number of cases retained for analysis:  10
##
##
##   BASIC ANALYSIS
##
##              Estimate    Std Err  t-value  p-value   Lower 95%   Upper 95%
## (Intercept)  -435.073    505.528   -0.861    0.422   -1672.056     801.909
##         DC1     0.669      0.543    1.232    0.264      -0.660       1.999
##       EXPF1     5.751      1.504    3.823    0.009       2.070       9.432
##       RSAM1     0.000      0.001    0.314    0.764      -0.001       0.002
##
## Standard deviation of Inv.Inc: 325.723
##
## Standard deviation of residuals:  101.194 for 6 degrees of freedom
## 95% range of residual variation:  495.224 = 2 * (2.447 * 101.194)
##
## R-squared:  0.936    Adjusted R-squared:  0.903    PRESS R-squared:  0.827
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 29.082     df: 3 and 6     p-value:  0.001
...
```

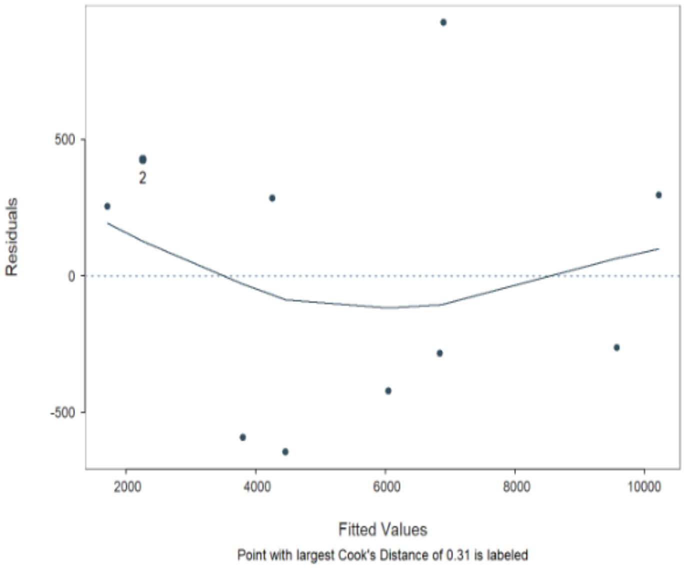
```
#Model version 1b.
log_T1 <- transform(ThesisData, logInv.Inc1 = log(Inv.Inc),logDC1 = log(DC1),logEXPF1 = log(EXPF1)) # LOG transformation
Regression(logInv.Inc1  ~ logDC1 + logEXPF1 + RSAM1,data= log_T1)
```

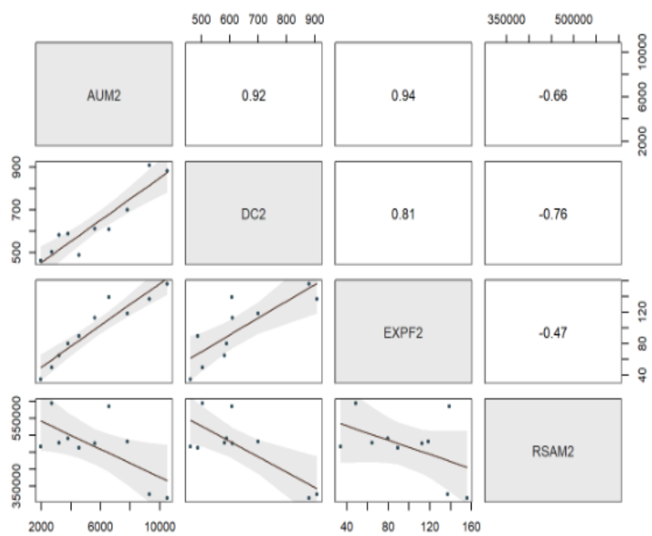



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=logInv.Inc1 ~ logDC1 + logEXPF1 + RSAM1, data=log_T1, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  log_T1
##
## Response Variable: logInv.Inc1
## Predictor Variable 1: logDC1
## Predictor Variable 2: logEXPF1
## Predictor Variable 3: RSAM1
##
## Number of cases (rows) of data:  10
## Number of cases retained for analysis:  10
##
##
##   BASIC ANALYSIS
##
##                 Estimate    Std Err  t-value  p-value    Lower 95%   Upper 95%
## (Intercept) -0.5822206  2.5694422   -0.227    0.828   -6.8694192   5.7049780
##      logDC1  0.3376880  0.4354456    0.775    0.467   -0.7278089   1.4031850
##    logEXPF1  1.0596280  0.1539489    6.883    0.000    0.6829287   1.4363274
##       RSAM1 -0.0000000  0.0000007   -0.062    0.953   -0.0000018   0.0000018
##
## Standard deviation of logInv.Inc1: 0.6022577
##
## Standard deviation of residuals:  0.1316198 for 6 degrees of freedom
## 95% range of residual variation:  0.6441242 = 2 * (2.447 * 0.1316198)
##
## R-squared:  0.968    Adjusted R-squared:  0.952    PRESS R-squared:  0.921
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 60.812     df: 3 and 6     p-value:  0.000
```

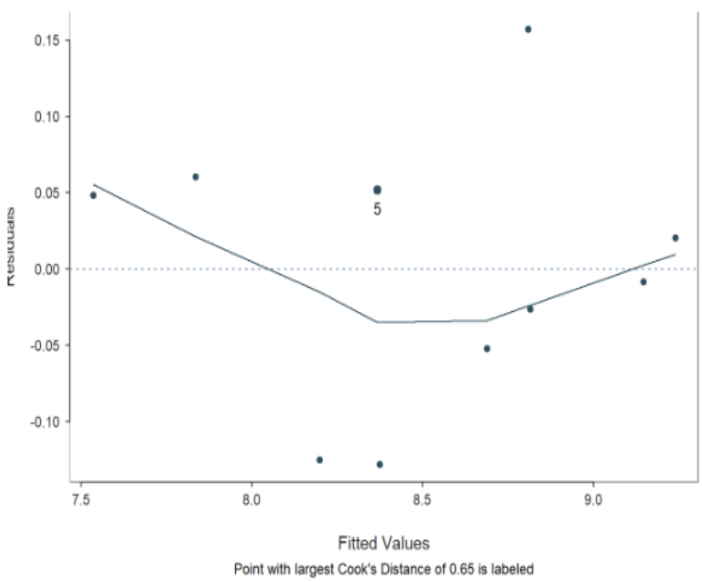
```
#Model version 2c.
ThesisData_v2 <-read.csv(file.choose(), header = T)
Regression(AUM2 ~ DC2 + EXPF2 + RSAM2,data= ThesisData_v2)
```

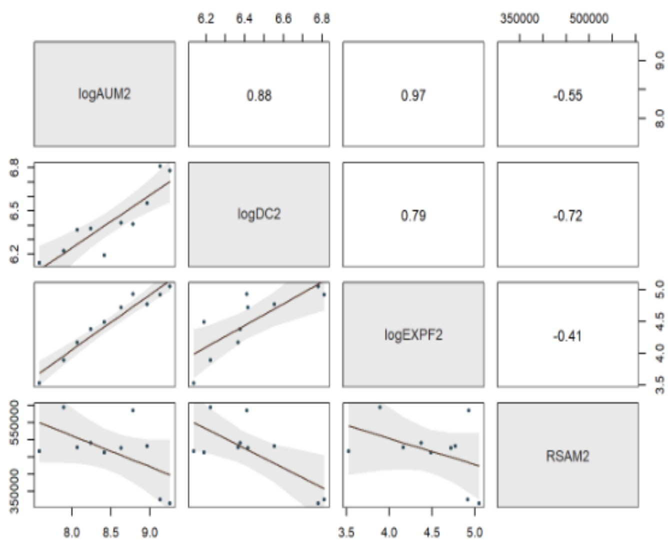



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=AUM2 ~ DC2 + EXPF2 + RSAM2, data=ThesisData_v2, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_v2
##
## Response Variable: AUM2
## Predictor Variable 1: DC2
## Predictor Variable 2: EXPF2
## Predictor Variable 3: RSAM2
##
## Number of cases (rows) of data:  10
## Number of cases retained for analysis:  10
##
##
##   BASIC ANALYSIS
##
##              Estimate    Std Err  t-value  p-value   Lower 95%   Upper 95%
## (Intercept) -1573.955   3139.943   -0.501    0.634   -9257.119    6109.210
##         DC2     6.837      3.375    2.026    0.089      -1.422      15.097
##       EXPF2    42.818      9.345    4.582    0.004      19.952      65.684
##       RSAM2    -0.003      0.004   -0.755    0.479      -0.012       0.006
##
## Standard deviation of AUM2: 2,895.199
##
## Standard deviation of residuals:  628.542 for 6 degrees of freedom
## 95% range of residual variation:  3,075.971 = 2 * (2.447 * 628.542)
##
## R-squared:  0.969    Adjusted R-squared:  0.953    PRESS R-squared:  0.925
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 61.652     df: 3 and 6     p-value:  0.000
```

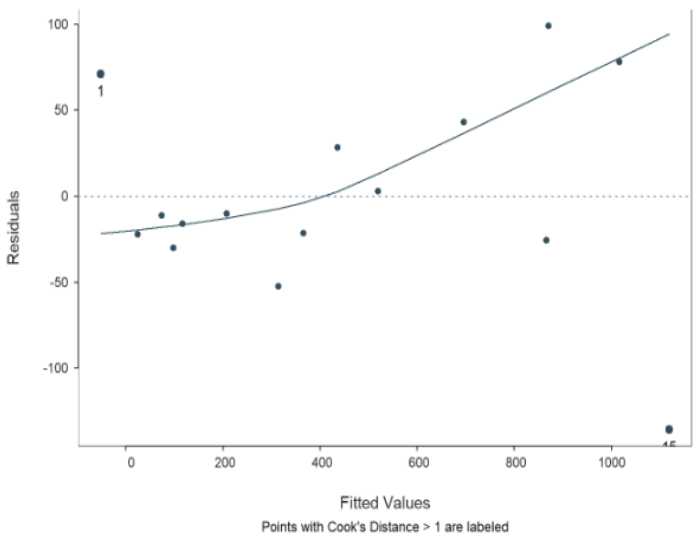
```
#Model version 2d.
log_T2 <- transform(ThesisData_v2, logAUM2 = log(AUM2),logDC2 = log(DC2),logEXPF2 = log(EXPF2)) # LOG transformation
Regression(logAUM2 ~ logDC2 + logEXPF2 + RSAM2,data= log_T2)
```

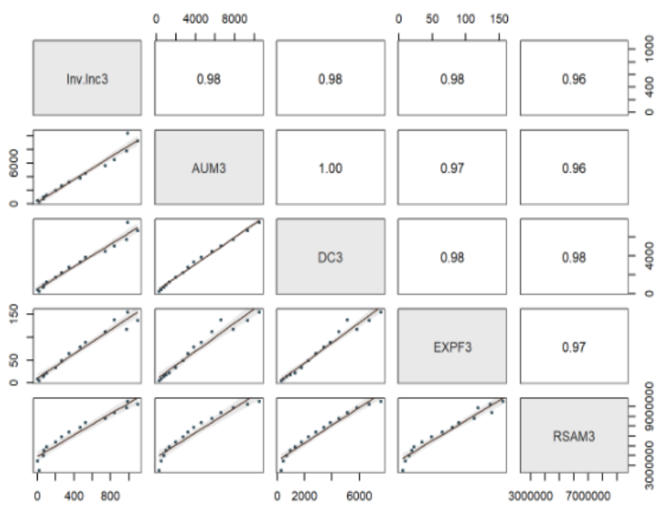



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=logAUM2 ~ logDC2 + logEXPF2 + RSAM2, data=log_T2, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  log_T2
##
## Response Variable: logAUM2
## Predictor Variable 1: logDC2
## Predictor Variable 2: logEXPF2
## Predictor Variable 3: RSAM2
##
## Number of cases (rows) of data:  10
## Number of cases retained for analysis:  10
##
##
##   BASIC ANALYSIS
##
##              Estimate    Std Err  t-value  p-value   Lower 95%   Upper 95%
## (Intercept)  1.1891952  2.0980395    0.567    0.591  -3.9445226   6.3229130
##      logDC2  0.5876234  0.3555570    1.653    0.149  -0.2823932   1.4576401
##    logEXPF2  0.8309034  0.1257063    6.610    0.001   0.5233113   1.1384956
##       RSAM2 -0.0000004  0.0000006   -0.679    0.523  -0.0000019   0.0000011
##
## Standard deviation of logAUM2: 0.5538428
##
## Standard deviation of residuals:  0.1074730 for 6 degrees of freedom
## 95% range of residual variation:  0.5259541 = 2 * (2.447 * 0.1074730)
##
## R-squared:  0.975    Adjusted R-squared:  0.962    PRESS R-squared:  0.941
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 77.670     df: 3 and 6     p-value:  0.000
##
```

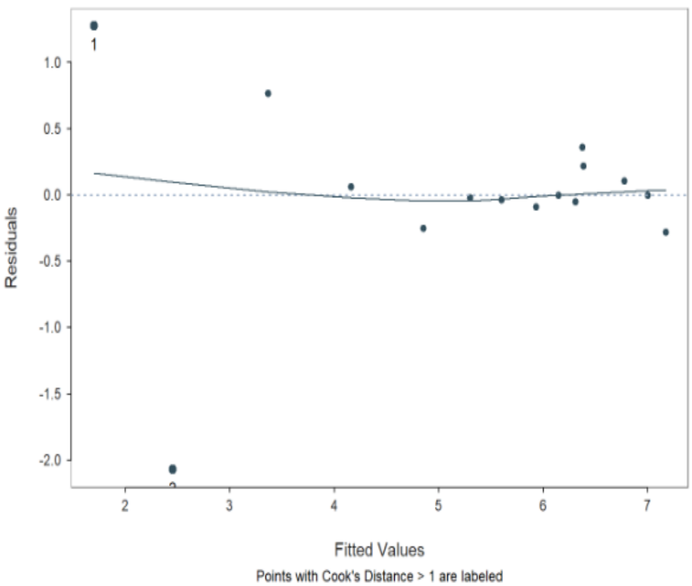
```
#Model version 3e.
ThesisData_v3 <-read.csv(file.choose(), header = T)
Regression(Inv.Inc3 ~ AUM3 + DC3 + EXPF3 + RSAM3,data= ThesisData_v3)
```

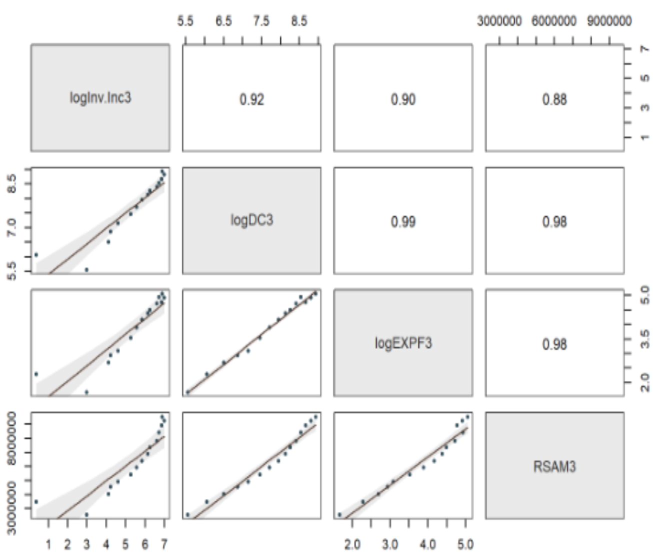



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=Inv.Inc3 ~ AUM3 + DC3 + EXPF3 + RSAM3, data=ThesisData_v3, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_v3
##
## Response Variable: Inv.Inc3
## Predictor Variable 1: AUM3
## Predictor Variable 2: DC3
## Predictor Variable 3: EXPF3
## Predictor Variable 4: RSAM3
##
## Number of cases (rows) of data:  15
## Number of cases retained for analysis:  15
##
##
##   BASIC ANALYSIS
##
##              Estimate   Std Err  t-value  p-value   Lower 95%  Upper 95%
## (Intercept) -231.74369  179.40651  -1.292    0.226  -631.48631  167.99893
##        AUM3    0.17551    0.10785   1.627    0.135    -0.06478    0.41581
##         DC3   -0.23525    0.21348  -1.102    0.296    -0.71092    0.24041
##       EXPF3    4.18764    2.21707   1.889    0.088    -0.75229    9.12757
##       RSAM3    0.00007    0.00006   1.137    0.282    -0.00006    0.00020
##
## Standard deviation of Inv.Inc3: 389.58197
##
## Standard deviation of residuals:  69.11526 for 10 degrees of freedom
## 95% range of residual variation:  307.99680 = 2 * (2.228 * 69.11526)
##
## R-squared:  0.978    Adjusted R-squared:  0.969    PRESS R-squared:  0.901
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 108.703     df: 4 and 10     p-value:  0.000
##
```

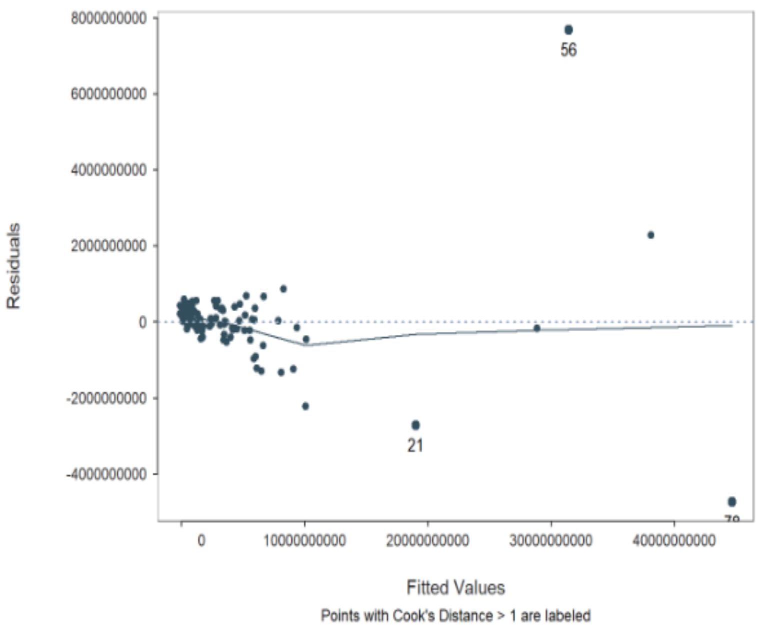
```
#Model version 3f.
log_T3 <- transform(ThesisData_v3,logInv.Inc3 = log(Inv.Inc3), logAUM3 = log(AUM3),logDC3 = log(DC3),logEXPF3 = log(EXPF3))
# LOG transformation
Regression(logInv.Inc3 ~ logDC3 + logEXPF3 + RSAM3,data = log_T3)
```

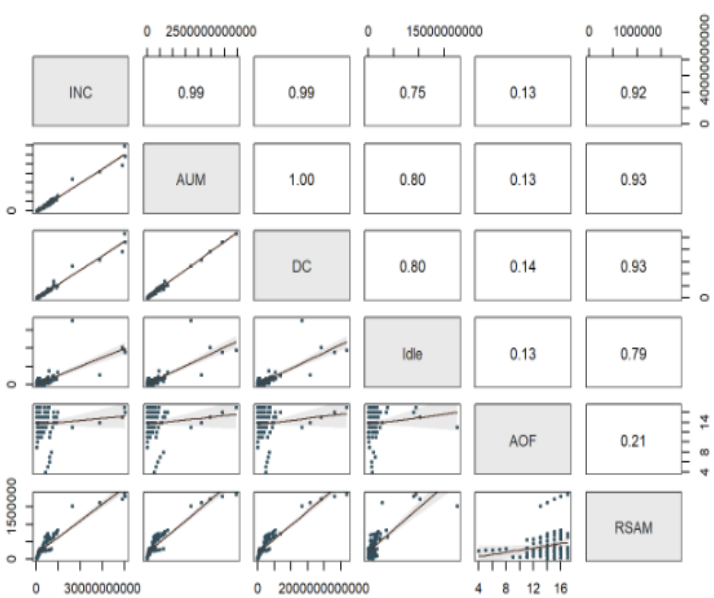



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=logInv.Inc3 ~ logDC3 + logEXPF3 + RSAM3, data=log_T3, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  log_T3
##
## Response Variable: logInv.Inc3
## Predictor Variable 1: logDC3
## Predictor Variable 2: logEXPF3
## Predictor Variable 3: RSAM3
##
## Number of cases (rows) of data:  15
## Number of cases retained for analysis:  15
##
##
##   BASIC ANALYSIS
##
##                  Estimate     Std Err  t-value  p-value     Lower 95%    Upper 95%
## (Intercept) -14.97395646  9.09640091   -1.646    0.128  -34.99499988   5.04708697
##      logDC3   3.48807912  2.20536931    1.582    0.142   -1.36590600   8.34206424
##    logEXPF3  -0.98228900  1.94010165   -0.506    0.623   -5.25242393   3.28784593
##       RSAM3  -0.00000043  0.00000049   -0.872    0.402   -0.00000150   0.00000065
##
## Standard deviation of logInv.Inc3: 1.81662406
##
## Standard deviation of residuals:  0.78926292 for 11 degrees of freedom
## 95% range of residual variation:  3.47431197 = 2 * (2.201 * 0.78926292)
##
## R-squared:  0.852    Adjusted R-squared:  0.811    PRESS R-squared:  0.611
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 21.056     df: 3 and 11     p-value:  0.000
```

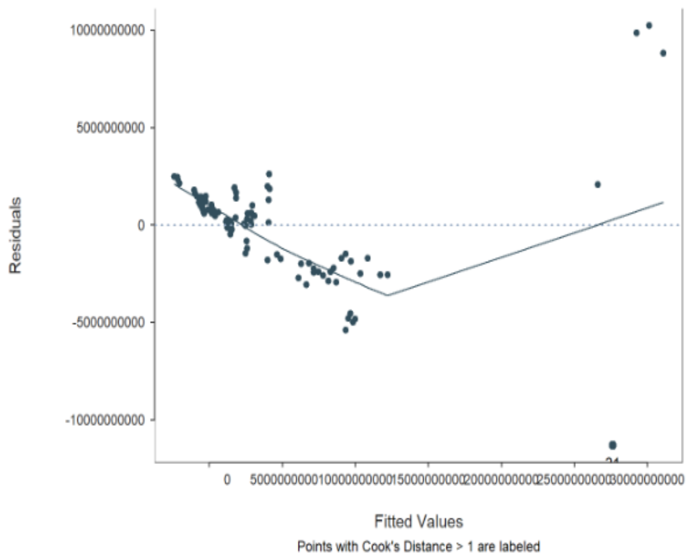
```r
#Model version 1a*.
ThesisData_updated <- read.csv(file.choose(), header = T)
Regression(INC ~ AUM + DC + Idle + AOF + RSAM, data= ThesisData_updated)
```

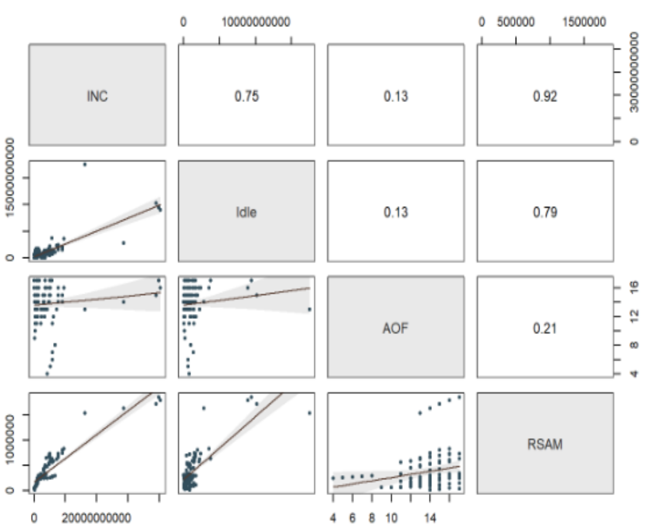



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=INC ~ AUM + DC + Idle + AOF + RSAM, data=ThesisData_updated, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_updated
##
## Response Variable: INC
## Predictor Variable 1: AUM
## Predictor Variable 2: DC
## Predictor Variable 3: Idle
## Predictor Variable 4: AOF
## Predictor Variable 5: RSAM
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                  Estimate       Std Err  t-value  p-value      Lower 95%      Upper 95%
## (Intercept) 695410397.508  637792933.681    1.090    0.278  -571676586.077  1962497381.093
##         AUM         0.009          0.003    3.503    0.001          0.004          0.014
##          DC         0.005          0.003    1.551    0.124         -0.001          0.012
##        Idle        -0.318          0.083   -3.849    0.000         -0.482         -0.154
##         AOF -44683479.208   47211942.853   -0.946    0.346  -138478244.091    49111285.676
##        RSAM      1675.343        916.676    1.828    0.071       -145.793       3496.479
##
## Standard deviation of INC: 7,411,875,780.935
##
## Standard deviation of residuals:  1,133,891,817.878 for 90 degrees of freedom
## 95% range of residual variation:  4,505,348,012.982 = 2 * (1.987 * 1,133,891,817.878)
##
## R-squared:  0.978    Adjusted R-squared:  0.977    PRESS R-squared:  0.933
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 793.833     df: 5 and 90     p-value:  0.000
```

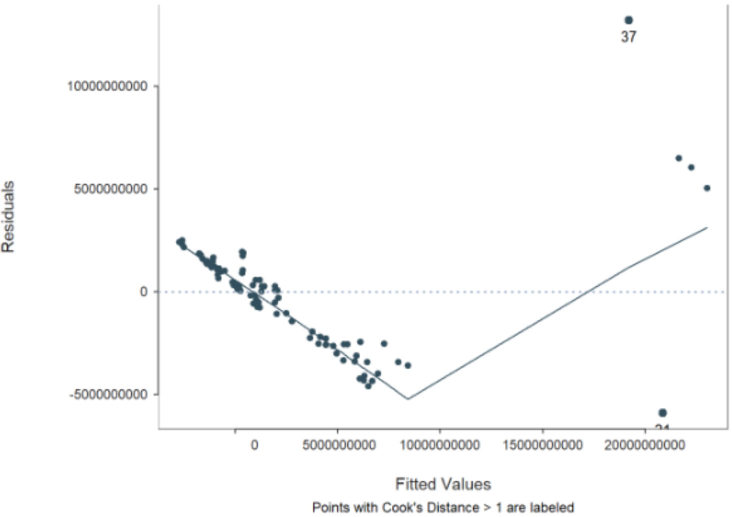
```r
#Model version 2b*.
Regression(INC ~ Idle + AOF + RSAM, data = ThesisData_updated)
```

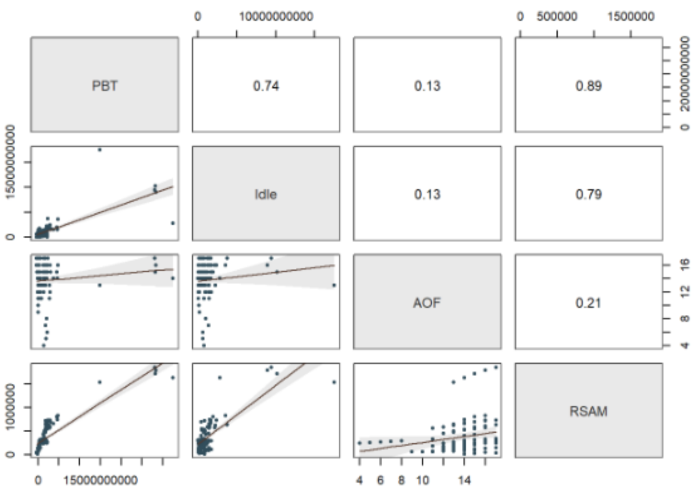



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=INC ~ Idle + AOF + RSAM, data=ThesisData_updated, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_updated
##
## Response Variable: INC
## Predictor Variable 1: Idle
## Predictor Variable 2: AOF
## Predictor Variable 3: RSAM
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                  Estimate        Std Err  t-value  p-value        Lower 95%       Upper 95%
## (Intercept)  473190798.614  1587156107.056    0.298    0.766  -2679038228.476  3625419825.705
##        Idle          0.166           0.199    0.835    0.406           -0.229           0.562
##         AOF -211660771.670   116342736.016   -1.819    0.072   -442727487.749    19405944.408
##        RSAM      17556.884        1278.615   13.731    0.000        15017.444       20096.324
##
## Standard deviation of INC: 7,411,875,780.935
##
## Standard deviation of residuals:  2,835,072,495.673 for 92 degrees of freedom
## 95% range of residual variation:  11,261,397,382.440 = 2 * (1.986 * 2,835,072,495.673)
##
## R-squared:  0.858    Adjusted R-squared:  0.854    PRESS R-squared:  0.650
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 185.770     df: 3 and 92     p-value:  0.000
```

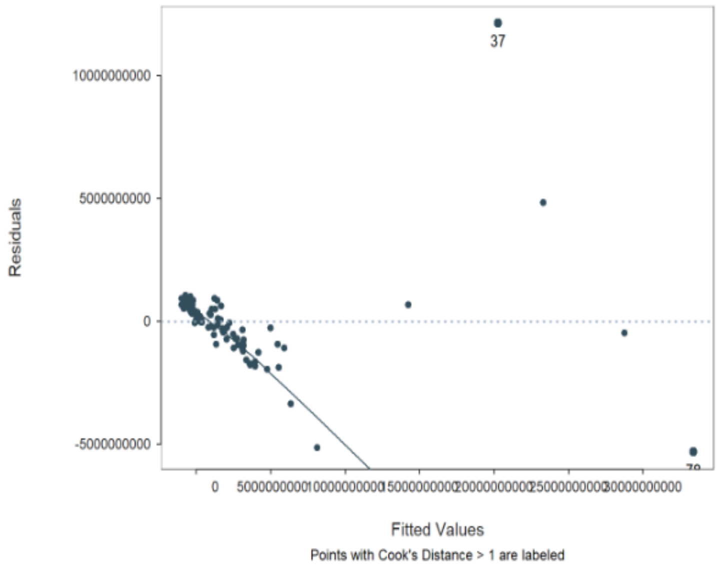
```
#Model version 2c*.
Regression(PBT ~ Idle + AOF + RSAM, data = ThesisData_updated)
```

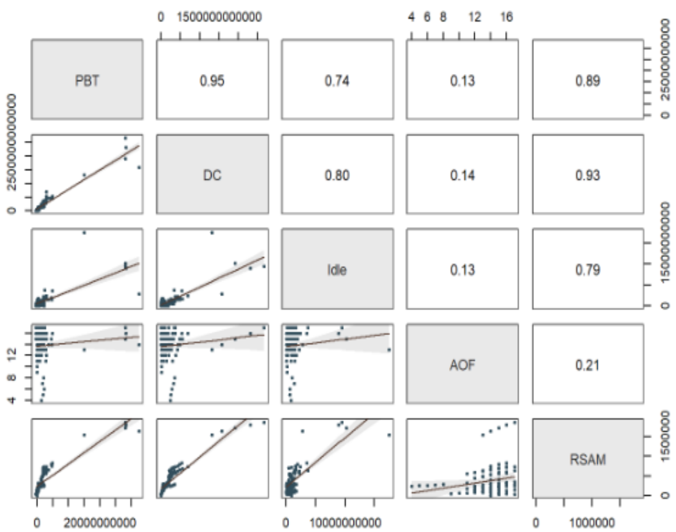



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=PBT ~ Idle + AOF + RSAM, data=ThesisData_updated, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_updated
##
## Response Variable: PBT
## Predictor Variable 1: Idle
## Predictor Variable 2: AOF
## Predictor Variable 3: RSAM
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                  Estimate        Std Err  t-value  p-value        Lower 95%       Upper 95%
## (Intercept) -844717770.553  1498854076.763   -0.564    0.574  -3821571343.518  2132135802.411
##        Idle          0.186           0.188    0.989    0.325           -0.188           0.560
##         AOF -143914897.640   109869963.896   -1.310    0.194   -362126129.578     74296334.298
##        RSAM      13209.264        1207.479   10.940    0.000        10811.107       15607.421
##
## Standard deviation of PBT: 5,910,530,563.558
##
## Standard deviation of residuals:  2,677,342,165.124 for 92 degrees of freedom
## 95% range of residual variation:  10,634,865,279.898 = 2 * (1.986 * 2,677,342,165.124)
##
## R-squared:  0.801    Adjusted R-squared:  0.795    PRESS R-squared:  0.665
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 123.662     df: 3 and 92     p-value:  0.000
```

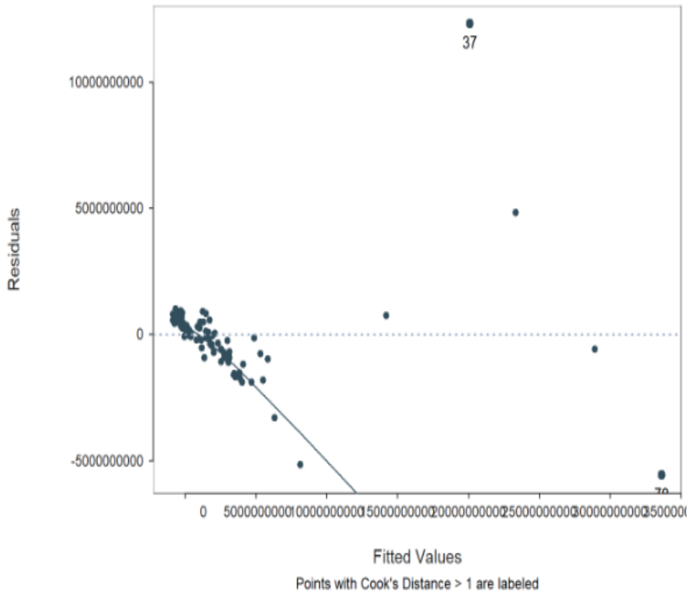
```r
#Model version 2d*.
Regression(PBT ~ DC + Idle + AOF + RSAM, data = ThesisData_updated)
```

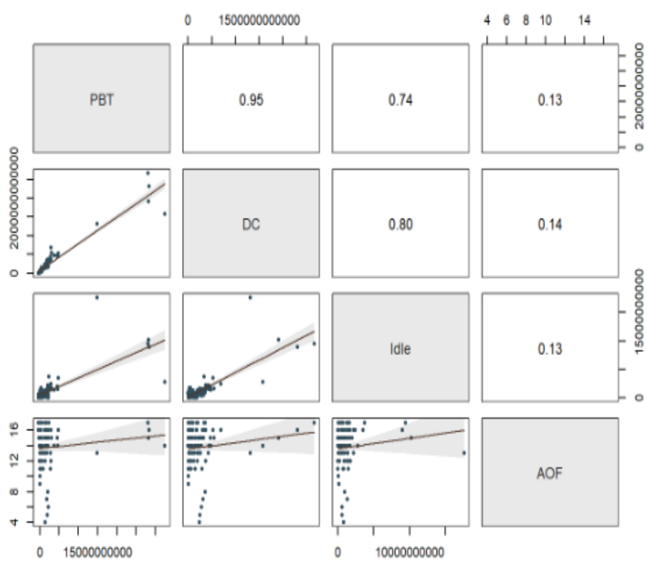



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=PBT ~ DC + Idle + AOF + RSAM, data=ThesisData_updated, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_updated
##
## Response Variable: PBT
## Predictor Variable 1: DC
## Predictor Variable 2: Idle
## Predictor Variable 3: AOF
## Predictor Variable 4: RSAM
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                   Estimate        Std Err  t-value  p-value        Lower 95%       Upper 95%
## (Intercept) -514131940.529  1010463006.510   -0.509    0.612  -2521292572.046  1493028690.988
##          DC          0.013           0.001   10.565    0.000           0.011           0.016
##        Idle         -0.176           0.131   -1.338    0.184          -0.436           0.085
##         AOF  -24823703.771    74887304.115   -0.331    0.741   -173578133.821    123930726.278
##        RSAM        594.495        1444.878    0.411    0.682        -2275.578        3464.567
##
## Standard deviation of PBT: 5,910,530,563.558
##
## Standard deviation of residuals:  1,804,083,416.387 for 91 degrees of freedom
## 95% range of residual variation:  7,167,180,165.955 = 2 * (1.986 * 1,804,083,416.387)
##
## R-squared:  0.911    Adjusted R-squared:  0.907    PRESS R-squared:  0.847
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 232.170     df: 4 and 91     p-value:  0.000
```

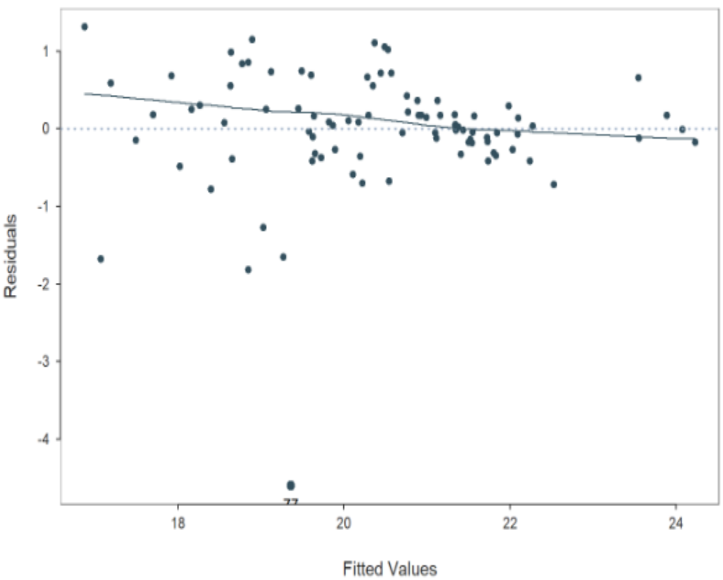
```
#Model version 2e*.
Regression(PBT ~ DC + Idle + AOF , data = ThesisData_updated)
```



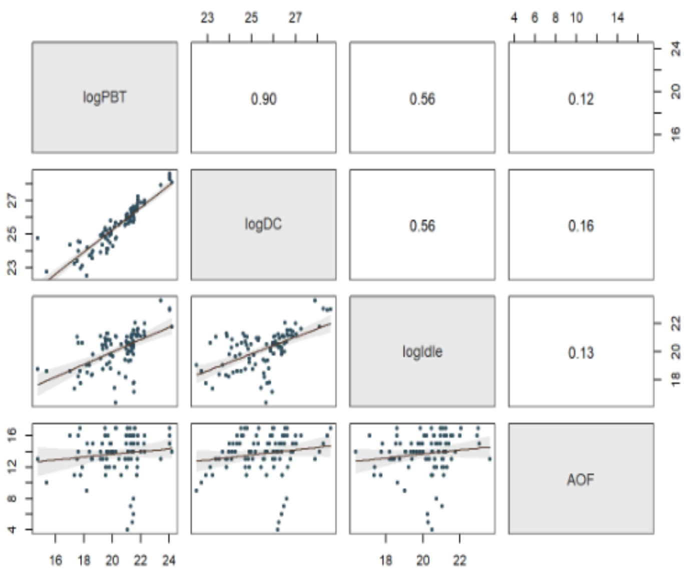




```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=PBT ~ DC + Idle + AOF, data=ThesisData_updated, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  ThesisData_updated
##
## Response Variable: PBT
## Predictor Variable 1: DC
## Predictor Variable 2: Idle
## Predictor Variable 3: AOF
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                  Estimate        Std Err  t-value  p-value        Lower 95%       Upper 95%
## (Intercept) -505011289.493  1005648625.831   -0.502    0.617  -2502316264.916  1492293685.931
##          DC          0.013           0.001   19.453    0.000            0.012           0.015
##        Idle         -0.164           0.128   -1.286    0.202           -0.418           0.089
##         AOF  -17789478.146    72579814.456   -0.245    0.807   -161939254.524   126360298.233
##
## Standard deviation of PBT: 5,910,530,563.558
##
## Standard deviation of residuals:  1,795,920,009.584 for 92 degrees of freedom
## 95% range of residual variation:  7,133,704,314.747 = 2 * (1.986 * 1,795,920,009.584)
##
## R-squared:  0.911    Adjusted R-squared:  0.908    PRESS R-squared:  0.864
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 312.323     df: 3 and 92     p-value:  0.000
```

```
lg <- transform(ThesisData_updated, logAUM = log(AUM),logDC = log(DC),logRSAM= log(RSAM),logIdle = log(Idle),logPBT=log(PB
T),logINC=log(INC))
#Model version 3f.
Regression(logPBT ~ logDC + logIdle + AOF, data = lg)
```

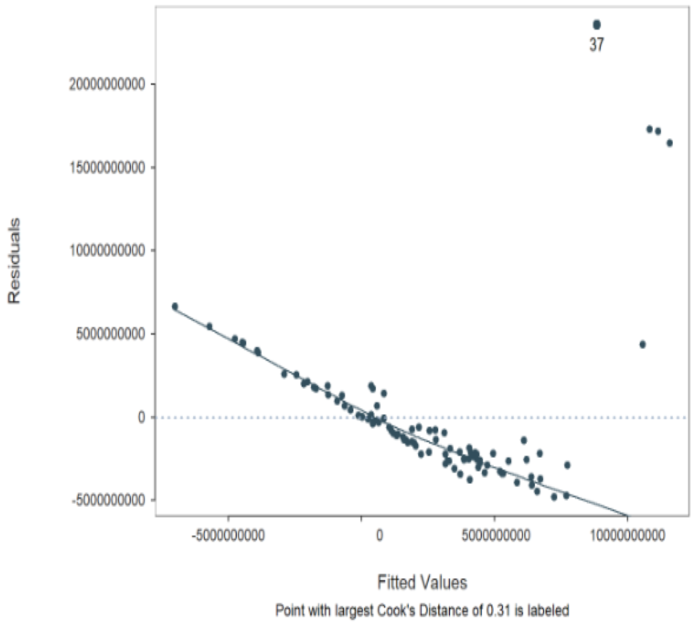


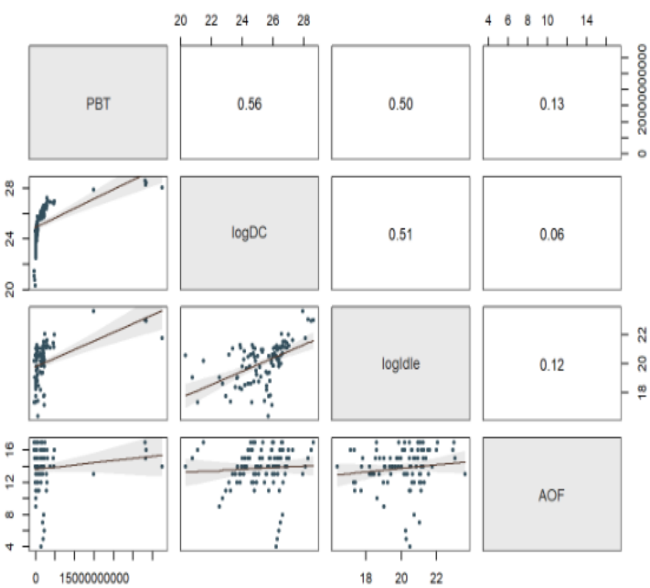

Point with largest Cook's Distance of 0.22 is labeled




```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=logPBT ~ logDC + logIdle + AOF, data=lg, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  lg
##
## Response Variable: logPBT
## Predictor Variable 1: logDC
## Predictor Variable 2: logIdle
## Predictor Variable 3: AOF
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  90
##
##
##   BASIC ANALYSIS
##
##              Estimate    Std Err  t-value  p-value    Lower 95%   Upper 95%
## (Intercept) -11.084848   1.656281   -6.693    0.000   -14.377426   -7.792270
##       logDC   1.161023   0.076361   15.204    0.000     1.009222    1.312823
##     logIdle   0.105185   0.071201    1.477    0.143    -0.036358    0.246727
##         AOF  -0.019244   0.031825   -0.605    0.547    -0.082510    0.044022
##
## Standard deviation of logPBT: 1.752760
##
## Standard deviation of residuals:  0.769738 for 86 degrees of freedom
## 95% range of residual variation:  3.060378 = 2 * (1.988 * 0.769738)
##
## R-squared:  0.814    Adjusted R-squared:  0.807    PRESS R-squared:  0.797
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 125.159     df: 3 and 86     p-value:  0.000
```

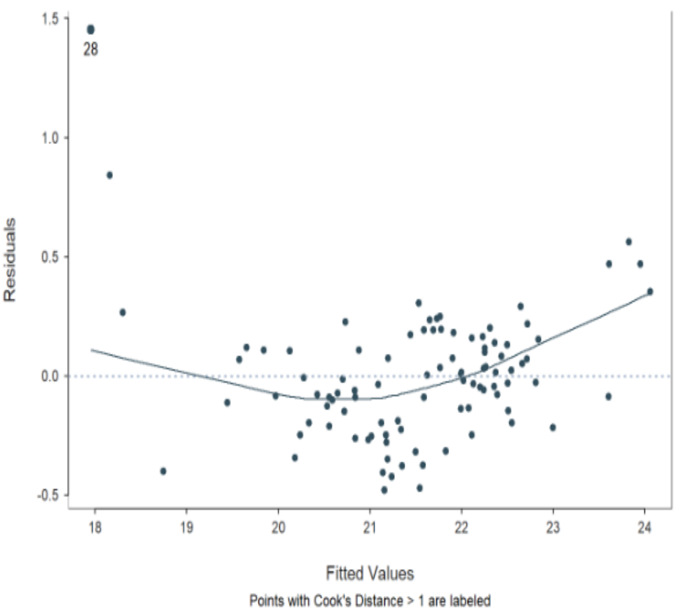
```
#Model version 3g.
Regression(PBT ~ logDC + logIdle + AOF, data = lg)
```

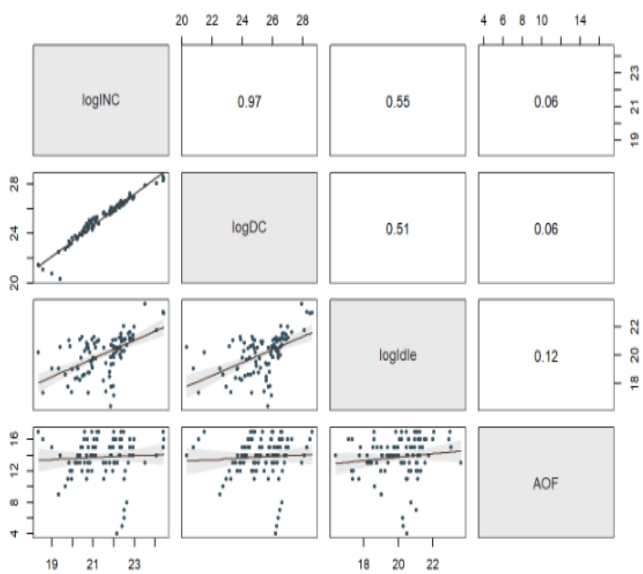



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=PBT ~ logDC + logIdle + AOF, data=lg, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  lg
##
## Response Variable: PBT
## Predictor Variable 1: logDC
## Predictor Variable 2: logIdle
## Predictor Variable 3: AOF
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                     Estimate        Std Err  t-value  p-value         Lower 95%         Upper 95%
## (Intercept) -63104322231.476  8685733830.577   -7.265    0.000  -80354939345.064  -45853705117.888
##       logDC   1572393814.957   358042274.680    4.392    0.000    861290952.325    2283496677.588
##     logIdle   1174276897.669   401682279.925    2.923    0.004    376501217.748    1972052577.590
##         AOF    159935378.155   189721581.646    0.843    0.401   -216868059.182     536738815.493
##
## Standard deviation of PBT: 5,910,530,563.558
##
## Standard deviation of residuals:  4,709,003,013.208 for 92 degrees of freedom
## 95% range of residual variation:  18,704,972,902.029 = 2 * (1.986 * 4,709,003,013.208)
##
## R-squared:  0.385    Adjusted R-squared:  0.365    PRESS R-squared:  0.304
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 19.221     df: 3 and 92     p-value:  0.000
```

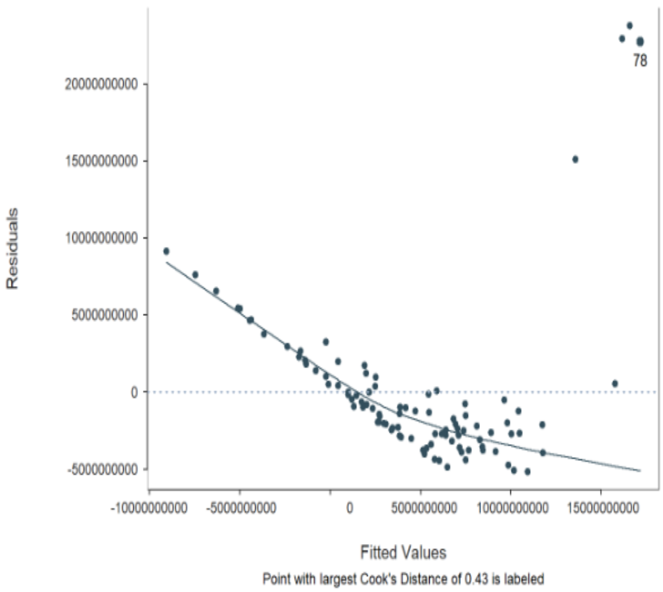
```
#Model version 3h.
Regression(logINC ~ logDC + logIdle + AOF, data = lg)
```

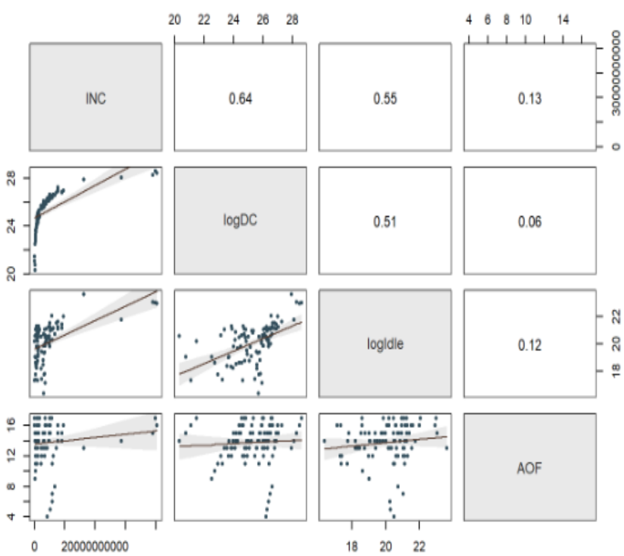



```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=logINC ~ logDC + logIdle + AOF, data=lg, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  lg
##
## Response Variable: logINC
## Predictor Variable 1: logDC
## Predictor Variable 2: logIdle
## Predictor Variable 3: AOF
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##              Estimate    Std Err  t-value  p-value   Lower 95%   Upper 95%
## (Intercept)  2.062562   0.519074    3.974    0.000    1.031637    3.093487
##       logDC  0.719674   0.021397   33.634    0.000    0.677177    0.762171
##     logIdle  0.063531   0.024005    2.647    0.010    0.015855    0.111208
##         AOF -0.003489   0.011338   -0.308    0.759   -0.026008    0.019029
##
## Standard deviation of logINC: 1.209908
##
## Standard deviation of residuals:  0.281418 for 92 degrees of freedom
## 95% range of residual variation:  1.117840 = 2 * (1.986 * 0.281418)
##
## R-squared:  0.948    Adjusted R-squared:  0.946    PRESS R-squared:  0.936
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 554.668     df: 3 and 92     p-value:  0.000
```

```
#Model version 3i.
Regression(INC ~ logDC + logIdle + AOF, data = lg)
```




```
## >>> Suggestion
## # Create an R markdown file for interpretative output with  Rmd = "file_name"
## Regression(my_formula=INC ~ logDC + logIdle + AOF, data=lg, Rmd="eg")
##
##
##   BACKGROUND
##
## Data Frame:  lg
##
## Response Variable: INC
## Predictor Variable 1: logDC
## Predictor Variable 2: logIdle
## Predictor Variable 3: AOF
##
## Number of cases (rows) of data:  96
## Number of cases retained for analysis:  96
##
##
##   BASIC ANALYSIS
##
##                   Estimate        Std Err  t-value  p-value         Lower 95%        Upper 95%
## (Intercept) -87398386808.800  9977278548.487   -8.760    0.000  -107214123214.361  -67582650403.239
##       logDC   2328556153.436   411282175.610    5.662    0.000     1511714252.050    3145398054.822
##     logIdle   1520670000.556   461411329.541    3.296    0.001      604267272.468    2437072728.643
##         AOF    176590782.126   217932658.732    0.810    0.420     -256242289.399     609423853.652
##
## Standard deviation of INC: 7,411,875,780.935
##
## Standard deviation of residuals:  5,409,218,802.336 for 92 degrees of freedom
## 95% range of residual variation:  21,486,350,897.429 = 2 * (1.986 * 5,409,218,802.336)
##
## R-squared:  0.484    Adjusted R-squared:  0.467    PRESS R-squared:  0.408
##
## Null hypothesis of all 0 population slope coefficients:
##   F-statistic: 28.788     df: 3 and 92     p-value:  0.000
```