Journal of Theoretical and Applied Information Technology
31st July 2022. Vol.100. No 14

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

BENFORD'S LAW AS A TOOL IN DETECTING FINANCIAL STATEMENT FRAUD

[1]ARYANTI WARDAYA PUPOKUSUMO, [2]BAMBANG LEO HANDOKO, [3]WILLY, [4]RICKY, [5]EDWIN HENDRA

[1]Management Department, Binus Business School, Jakarta, Indonesia, 11480.

[2]Accounting Department, School of Accounting, Jakarta, Indonesia, 11480.

[3]Accounting Department, School of Accounting, Jakarta, Indonesia, 11480.

[4]Accounting Department, School of Accounting, Jakarta, Indonesia, 11480.

[5]Accounting Department, School of Accounting, Jakarta, Indonesia, 11480.

E-mail: [1]rpuspokusumo@binus.edu , [2]bambang.handoko@binus.edu , [3]willy011@binus.ac.id , [4]ricky020@binus.ac.id, [5]edwin@binus.ac.id

ABSTRACT

Currently, fraud related to financial statement fraud is increasingly happening. The parties who are harmed are investors and creditors who make decisions based on the financial statements. Benford's Law is here as one of the tools to detect fraudulent financial statements. Benford's law is the study of the frequency of the principal digits contained in numerical data. It is also commonly used in predicting the occurrence of numbers in numerical data, including auditing financial statements. When an Auditor chooses a method of detecting fraud / material misstatement of data, he should first consider which types of accounts that may be analyzed by the Benford method are expected to be effective or not, While most of the accounting data sets related to the Benford distribution are in accordance with the Benford distribution because digital analysis is only effective when applied to the appropriate data set. Auditors need to consider in advance the expectations for the use of the Benford method distribution before conducting digital analysis. The purpose of this study is that we want to demonstrate the effectiveness of the Benford Law method in assisting the auditing process. Our research result show that Benford Law method is still effective in helping auditors detect fraud. It can be seen from the results that we get we can assess the size of the anomaly, the risk of fraud, and changes in deviation so that it gives rise to indications of fraud in Total Assets, Total Liability, and Total Equity by using the Benford Law method, namely First Digit Test, First Two-Digit Test, and Chi-Square Test.

Keywords: *Benford Law, Data Fraud, Audit, Transportation, Accounting*

1. INTRODUCTION

This At this time, fraud has become a common events. In almost all sectors and lines of business, fraud had occur. The bigger the business we are running, the greater the possibility of fraud occurring if the management does not have proper and good corporate governance.

As time goes by, the types and methods of fraud are also growing in Indonesia, one of which often occurs is corruption. Based on a survey conducted by ACFE Indonesia in 2019, it was found that fraud that often occurs in Indonesia is Corruption by 64.4% then there is Misuse of State and Company Assets / Wealth by 28.9% and Financial Report Fraud by 6.7% [1].

Along with the development of various methods of fraud that occur, the auditors, definitely also need various effective methods in detecting fraud in financial statements. Auditor need to evolve and catch up with the technology development in order to balance the evolution of fraud method which also use technology. The use of information technology is necessary in supporting auditor work. One of the technological tools that can be used is the Benford's Law method. Benford Law itself studies the frequency of the principal digits contained in numerical data. In 1938, there was a physicist named Frank Benford where he discovered that for the occurrence of the first digit of a number starting from the most minor 1, which is more likely than the number 2, then the number 2 has a greater probability than the number 3, and so on. Benford's law is

commonly used to predict numbers in numerical data, including auditing financial statements.

Based on the results found in Benford's Law testing of PT Garuda Indonesia (Persero) Tbk. Previously conducted by Theresia Hesti Bwarleling said that the Financial Statements of PT Garuda Indonesia (Persero) Tbk. In 2018 which has undergone a restatement or restatement following the Financial Services Authority Letter No. S-21/PM.1/2019 has been tested to follow Benford's Law data distribution. Therefore, it can be concluded that the pattern of distribution of figures in this law is also in line with the scheme for preparing good and correct financial statements and the discovery of one significant deviation in the proportion of data on the financial statements of PT Garuda Indonesia (Persero) Tbk. The year 2017 is on the First Digit Test and the fourth digit. If we look further, the data deviations from these accounts (with nominal values starting with the number four) were later requested to be restated or restated in 2018, according to the request of the Financial Services Authority (OJK Letter No. S-21/PM.1/2019) [2].

In a survey conducted on 86 Accountants to gain insight into fraud detection and prevention methods perceptions. Bierstaker, Brody, Pacini (2006) found that accountants rated "digital analysis" based on Benford's law as the 10th most effective procedure in fraud detection. This proves that the Benford Law method is one of the ten most effective procedures in fraud detection [3].

Based on the description of the background above, the authors formulate several problems in the research, including:

1. How to detect Total Asset fraud using the Benford Law method?
2. How to detect Total Liability fraud using the Benford Law method?
3. How to detect Total Equity fraud using the Benford Law method?
4. What are the guidelines for detecting fraud in the Benford Law method?

2. LITERATURE REVIEW AND THEORITICAL FOUNDATIONS

2.1 Financial Statement Fraud

Fraudulent Financial Reporting is the intentional misstatement or omission of amounts and disclosures to deceive users of financial statements. This fraud usually occurs when a company overstates assets or revenues or understates liabilities and expenses [4].

According to ACFE, fraud is divided into three types based on actions, namely [4]:

1. Misappropriation of assets (asset misappropriation); Asset misappropriation includes misuse/theft of assets or property of the company or other parties. This is the most accessible form of fraud to detect because it is tangible or can be measured/calculated (defined value).
2. False statement or false statement (Fraudulent Statement); Fraudulent statements include actions taken by officials or executives of a company or government agency to cover up the actual financial condition by carrying out financial engineering in the presentation of its financial statements to gain profits or may be analogous to the term window dressing
3. Corruption (Corruption). This type of fraud is the most difficult to detect because it involves cooperation with other parties, such as bribery and corruption. This is the most common type in developing countries where law enforcement is weak and lacks awareness of good governance, so the integrity factor is still lacking. Questionable. This type of fraud often cannot be detected because the parties working together enjoy the benefits (mutualism symbiosis). This includes abuse of authority/conflict of interest, bribery, illegal receipts (illegal gratuities), and economic extortion

2.2 Benford's Law

Benford's law was born out of empirical experiments conducted by Newcomb (1881) and Benford (1938), who observed that there are more numbers, with the first one being than the first 2, with the first two being 3, and so on [5].

According to Arkan (2010), Nigrini was the first to extensively use Benford's Law in accounting data to detect fraud. Benford's Law is widely used in various fields because of its ability to detect data anomalies in a data set. These data anomalies, if explored further, can detect fraud [6].

Before this Benford Law can be applied effectively, the numbers in the data must meet several prerequisites, namely [6]:

1. There is no specific number lower limit

2. More small values or numbers than large ones (e.g., more units, tens, hundreds than hundreds of thousands or tens of millions).
3. Minimum 1000 data
4. Is a natural number (not a list of numbers in the form of telephone numbers, ID cards, NPWP, and the like)
5. Derived from similar or similar transactions (e.g., data on the number of purchases per consumer in a specific month)
6. If the data is sorted from smallest to largest, it forms a geometric series
7. The data has an average value (mean) more significant than the median value.
8. The data has a positive skewness value

2.3 Application of Benford Law in Accounting and Auditing

Benford's law is commonly used in accounting and auditing to examine data for anomalies that indicate fraud. Accounting data generally follow the four assumptions required for valid conclusions on the Benford curve, i.e. the general ledger, income statement, and inventory list can all be compared with the turn to determine its authenticity. With Benford's Law, this can help test 100% of transactions and allow Auditors and Accountants to assess the risk of data being erroneous, manipulated or fraudulent. Based on the risk assessment, the Auditor and Accountant may then choose to apply further and specific audit procedures.

2.4 Hypothesis Development

2.4.1 Effect of First Digit Method in detecting Fraud in Financial Statements

This model tests the first digit test model, which will compare the Actual Frequency distribution with the Frequency distribution developed by Benford. This test only identifies the presence or absence of anomalies in the data being tested. Therefore, it cannot be used for the selection of the target sample, because the samples to be taken will be too many [7]. Based on this description, the following hypothesis is proposed:

H1 = The First Digit Test shows an anomaly in the financial statements

2.4.2 Effect of First Two-Digit Method in detecting Fraud in Financial Statements

This model tests the first digit test model, which will compare the Actual Frequency distribution with the Frequency distribution developed by Benford. This test only identifies the presence or absence of anomalies in the data being tested. Therefore, it cannot be used for the selection of the target sample, because the samples to be taken will be too many [7]. Based on this description, the following hypothesis is proposed:

H2 = The First Digit Test shows an anomaly in the financial statements

2.4.3 Effect of Chi-Square Method in detecting Fraud in Financial Statements

The Chi-squared formula can be used to test whether there is a significant difference between the distribution of the occurrence of the actual number and the distribution of the emergence of the expected number [7]. By using this formula, we can measure the level of spread of deviations experienced by data so that we can see whether there are significant deviations that contain fraud or not. [7]. Based on the description above, the following hypothesis is proposed:

H3 = Chi-Square Test shows that the deviation pattern is still within the reasonable level of the Financial Statements

3. RESEARCH METHODOLOGY

3.1 Population and Data Sample

According to Sugiyono (2014), the object of research is an attribute or activity with a particular variation set by the researcher to be studied and then concluded [8]. In this paper, the object of our research is a transportation sector company listed on IDN Financial in 2015-2020.

The method of data collection in this study is to download secondary data in the form of financial statements of the companies that are the research sample. The data source is from the idx.go.id website and IDN Finance

Quantitative Research based on V. Wiratna Sujarweni (2014) produces findings that can be achieved using statistical procedures or other means of quantification [9]. The population in this study includes public transportation companies registered with IDN Financial in 2021. Based on IDN Financial, 49 public transportation companies will be registered with IDN Financial in 2021. The sampling method used in this study is the Purposive Sampling method. Researchers choose samples with the following criteria:

1. Transportation Sector Companies registered with IDN Financial for the 2015-2020 period
2. Transportation Sector Companies that present complete financial reports for the 2015-2020 period

Journal of Theoretical and Applied Information Technology
31st July 2022. Vol.100. No 14

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Based on the results we selected, about 25 out of 49 companies met the predetermined sample criteria.

3.2 Benford Law Digits Test

3.2.1 First Digit Test

Based on Nigrini (2012), The First Digit Test is formulated as follows [10]:

$$P(d) = Log_{10}\left(1+\frac{1}{d}\right), d \in (1, \dots, \dots, 9)$$

3.2.2 First Two-Digits Test

Based on Nigrini (2012), The First Two-Digits Test is formulated as follows [10]:

$$P(d1d2) = Log_{10}\left(1+\frac{1}{d1d2}\right),$$
$$d1d2 \in (11, 12, 13, \dots, 99)$$

3.2.3 Chi-Square Test

Chi-Square Test is formulated as follows [7]:

$$X^2 = \sum \frac{(AC-EC)^2}{EC}$$

4. RESULT AND DISCUSSION

In this paper, we use guidelines (Nigrini, 2012) to test the compatibility of the first-digit test and the first two-digit test [11]. The guidelines for the first digit test are as follows:

- MAD = 0,000 to 0,006 = Close Conformity
- MAD = 0,006 to 0,012 = Acceptable Conformity
- MAD = 0.012 to 0,015 = Marginally Acceptable Conformity
- MAD > 0,015 = Nonconformity

While the guidelines for the first two-digit test are:

- MAD = 0,0000 ± 0,0012 (Close Conformity)
- MAD = 0,0012 ± 0,0018 (Acceptable Conformity)
- MAD = 0,0018 ± 0,0022 (Marginally Acceptable Conformity)
- MAD > 0,0022 (Nonconformity)

And also, in this Chi-Square method, we use a fixed probability of 5% as a calculation of the Cut Off Value (using the Excel CHIINV formula) with Degrees of Freedom of 5. The cut-off value we use is 11.07049769(=CHIINV(0.05;5)).

4.1 Total Asset

4.1.1 First Digit & Chi-Square Test

Table 1: First Digit & Chi-Square Test Total Assets of Transportation Sector Companies 2015-2020

Actual	Benford	Difference	Abs	Chi Square
0,180	0,301	-0,121	0,121	7,296
0,207	0,176	0,031	0,031	0,802
0,200	0,125	0,075	0,075	6,750
0,107	0,097	0,010	0,010	0,145
0,080	0,079	0,001	0,001	0,002
0,047	0,067	-0,020	0,020	0,926
0,087	0,058	0,029	0,029	2,125
0,047	0,051	-0,004	0,004	0,055
0,047	0,046	0,001	0,001	0,001
1	1	0,000	0,292	18,102
		MAD	0,001946667	

Based on the results from the table 1, we get a MAD of 0.001946667, which is included in the "Close Conformity" category so that it can be interpreted that the row of numbers meets Benford's Law. However, two oddities are found in the rows of numbers 1 and 3. They have a significant difference between the Actual Count and the Expected Count, which makes Hypothesis H1 accepted for these findings.

Based on the results from the Table 1, we get the Total Chi-Square value (18.102) which is greater than the Cut Off Value (11.07049769), so that it can be interpreted that Chi-Square in the First Digit Test shows a pattern of spread of deviations at an unnatural level so that it is indicated there is fraud which makes Hypothesis H3 rejected.

4.1.2 First Two-Digit & Chi-Square Test

Table 2: First Two-Digit & Chi-Square Test Total Assets of Transportation Sector Companies 2015-2020

NOTE: in reading this table, assume the first digit of the multi-digit data number is 2

Actual	Benford	Difference	Abs	Chi Square
0,153	0,120	0,034	0,034	1,4195
0,113	0,114	-0,001	0,001	0,0004
0,127	0,109	0,018	0,018	0,4390
0,073	0,104	-0,031	0,031	1,3814
0,087	0,103	-0,017	0,017	0,4022
0,073	0,097	-0,023	0,023	0,8457
0,080	0,093	-0,013	0,013	0,2872
0,093	0,090	0,003	0,003	0,0148
0,113	0,088	0,026	0,026	1,1369
0,087	0,085	0,002	0,002	0,0049
1	1	0	0,167	5,9320
		MAD	0,0011122	

Based on the results from the table 2, we get a MAD of 0.0011122, which is included in the "Close Conformity" category. It can be interpreted that the Total Assets report has a low risk of fraud makes Hypothesis H2 rejected.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Based on the results from the table 2, we get the Total Chi-Square value (5.9320) which is smaller than the Cut Off Value (11.07049769), so that it can be interpreted that the Chi-Square on the First Digit Test shows the pattern of the spread of the deviation is still within a reasonable level, so it is not indicated that there was fraud which made Hypothesis H3 accepted.

4.2 Total Liability

4.2.1 First Digit & Chi-Square Test

Table 3: First Digit & Chi-Square Test Total Liability of Transportation Sector Companies 2015-2020

Actual	Benford	Difference	Abs	Chi Square
0,307	0,301	0,0057	0,0057	0,0160
0,107	0,176	-0,0693	0,0693	4,0970
0,153	0,125	0,0283	0,0283	0,9633
0,100	0,097	0,0030	0,0030	0,0139
0,060	0,079	-0,0190	0,0190	0,6854
0,067	0,067	0,0000	0,0000	0,0002
0,053	0,058	-0,0047	0,0047	0,0563
0,100	0,051	0,0490	0,0490	7,0618
0,053	0,046	0,0073	0,0073	0,1754
1	1	0	0,1863	13,0694
		MAD	0,001242	

Based on the result from the table 3, we get a MAD of 0.001242, which is included in the "Marginally Close Conformity" category, so it can be interpreted that the row of numbers is almost not following Benford's Law. However, there are two oddities found in the series of numbers 2 and 8, which have a significant difference between Actual Count and Expected Count, making Hypothesis H1 accepted for these findings.

Based on the results from the table 3, we get the Total Chi-Square value (13.0694) which is greater than the Cut Off Value (11.07049769), so that it can be interpreted that the Chi-Square in the First Digit Test shows the pattern of spread of the deviation in an unnatural level so that it is indicated there is a fraud that makes Hypothesis H3 rejected.

4.2.2 First Two-Digit & Chi-Square Test

Table 4: First Two-Digit & Chi-Square Test Total Liability of Transportation Sector Companies 2015-2020

NOTE: in reading this table, assume the first digit of the multi-digit data number is 2

Actual	Benford	Difference	Abs	Chi Square
0,120	0,120	0,0003	0,0003	0,0001
0,120	0,114	0,0061	0,0061	0,0492
0,080	0,109	-0,0288	0,0288	1,1449
0,020	0,104	-0,0843	0,0843	10,2246
0,100	0,103	-0,0033	0,0033	0,0159
0,120	0,097	0,0233	0,0233	0,8437
0,120	0,093	0,0266	0,0266	1,1393
0,107	0,090	0,0163	0,0163	0,4420
0,113	0,088	0,0258	0,0258	1,1369
0,100	0,085	0,0150	0,0150	0,3971
1	1	0	0,2299	15,3937
		MAD	0,0015328	

Based on the result from the table 2.2, we get a MAD of 0.0015328, which is included in the "Acceptable Conformity" category. It can be interpreted that the Total Liability report has a relatively low-risk fraud which makes hypothesis H2 rejected.

Based on the results from the table 2.2, we get the Total Chi-Square value (15.3937) which is greater than the Cut Off Value (11.07049769), so that it can be interpreted that the Chi-Square on the First Digit Test shows the pattern of spread of the deviation at an unnatural level so that it is indicated there is a fraud that makes Hypothesis H3 rejected.

4.3 Total Equity

4.3.1 First Digit & Chi-Square Test

Table 5: First Digit & Chi-Square Test Total Equity of Transportation Sector Companies 2015-2020

Actual	Benford	Difference	Abs	Chi Square
0,173	0,301	-0,128	0,128	8,122
0,227	0,176	0,051	0,051	2,188
0,113	0,125	-0,012	0,012	0,163
0,180	0,097	0,083	0,083	10,653
0,120	0,079	0,041	0,041	3,192
0,027	0,067	-0,040	0,04	3,642
0,060	0,058	0,002	0,002	0,010
0,060	0,051	0,009	0,009	0,238
0,040	0,046	-0,006	0,006	0,117
1	1	0	0,372	28,326
		MAD	0,00248	

Based on the result from the table 1.3, we get a MAD of 0.00248, which is included in the "Close Conformity" category, so it can be interpreted that the row of numbers meets Benford's Law. However, there are some oddities in the series of numbers 1, 2, 4, 5, and 6, which have a significant difference between the Actual Count and Expected Count, making Hypothesis H1 accepted for these findings.

Based on the results from the table 1.3, we get the Total Chi-Square value (28.326) which is

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

greater than the Cut Off Value (11.07049769), so that it can be interpreted that the Chi-Square in the First Digit Test shows a pattern of spread of deviations at an unnatural level so that it is indicated there is a fraud that makes Hypothesis H3 rejected.

4.3.2 First Two-Digit & Chi-Square Test

Table 6: First Two-Digit & Chi-Square Test Total Equity of Transportation Sector Companies 2015-2020

NOTE: in reading this table, assume the first digit of the multi-digit data number is 2

Count	Benford	Difference	Abs	Chi Square
0,100	0,120	-0,020	0,020	0,4854
0,127	0,114	0,013	0,013	0,2150
0,140	0,109	0,031	0,031	1,3401
0,127	0,104	0,022	0,022	0,7173
0,087	0,103	-0,017	0,017	0,4022
0,067	0,097	-0,030	0,030	1,3976
0,087	0,093	-0,007	0,007	0,0722
0,067	0,090	-0,024	0,024	0,9312
0,093	0,088	0,006	0,006	0,0569
0,107	0,085	0,022	0,022	0,8284
1	1	0	0,190	6,4464
		MAD	0,00127	

Based on the result from the table 2.3, we get a MAD of 0.00127, which is included in the "Acceptable Conformity" category, so it can be interpreted that the Total Equity report has a relatively low risk of fraud which makes Hypothesis H2 rejected.

Based on the results from the table 2.3, we get the Total Chi-Square value (6.4464) which is smaller than the Cut Off Value (11.07049769), so that it can be interpreted that the Chi-Square on the First Digit Test shows the deviation spread pattern is still within a reasonable level, so it is not indicated that there was fraud which made Hypothesis H3 accepted.

5. RESULT AND DISCUSSION

Based on our tests, it is proven that the Benford Law method is still effective in helping auditors detect fraud. It can be seen from the results that we get we can assess the size of the anomaly, the risk of fraud, and changes in deviation so that it gives rise to indications of fraud in Total Assets, Total Liability, and Total Equity by using the Benford Law method, namely First Digit Test, First Two-Digit Test, and Chi-Square Test.

We suggest using the Benford Law method to make sure the data is large/big data for further research. The results obtained are also better because the Benford's Law method itself depends on the amount of data being tested. The more data tested, the better the results of the Benford's Law method itself will be. Therefore, large companies or industries and auditors are expected to consider the application of Benford Law in helping detect data fraud.

REFERENCES:

[1] ACFE Indonesia, "Survei Fraud Indonesia 2019," *Indones. Chapter #111*, vol. 53, no. 9, pp. 1–76, 2020, [Online]. Available: https://acfe-indonesia.or.id/survei-fraud-indonesia/.

[2] T. H. Bwarleling, "Aplikasi Hukum Benford Dalam Menganalisa Kasus Garuda Indonesia," *J. Akunt. Bisnis*, vol. 13, no. 2, pp. 78–99, 2020, doi: 10.30813/jab.v13i2.2240.

[3] C. Goh, "Applying visual analytics to fraud detection using Benford's law," *J. Corp. Account. Financ.*, vol. 31, no. 4, pp. 202–208, 2020, doi: 10.1002/jcaf.22440.

[4] Meiryani, "MEMAHAMI FRAUD DALAM LAPORAN KEUANGAN," *Accounting Binus*, 2019. .

[5] C. G. da Silva and P. M. R. Carreira, "Selecting audit samples using Benford's law," *Auditing*, vol. 32, no. 2, pp. 53–65, 2013, doi: 10.2308/ajpt-50340.

[6] M. Murhaban and J. Jufrizal, "Analisis Penggunaan Benford'S Law Dalam Perencanaan Audit Di Direktorat Jenderal Bea Dan Cukai Cabang Kota Lhokseumawe," *J. Akunt. dan Keuang.*, vol. 5, no. 1, p. 38, 2017, doi: 10.29103/jak.v5i1.1812.

[7] T. H. Bwarleling, "Pendeteksian Fraud dengan Hukum Benford," *J. Akunt. Bisnis*, vol. 4, no. 2, pp. 56–74, 2017, [Online]. Available: https://core.ac.uk/download/pdf/268047897.pdf.

[8] K. Adam and D. Steffi, "Metode Analisis Deskriptif," *J. Metod. Ilmliah*, vol. 2, no. 3, p. 12, 2015.

[9] R. B. Pratama, "Metodologi Penelitian," *Angew. Chemie Int. Ed. 6(11), 951–952.*, pp. 28–55, 2019.

[10] A. Aybars, "An application of Benford s law to fundamental accounting figures reported by Borsa Istanbul (BIST) companies," *Pressacademia*, vol. 3, no. 3, pp. 234–234, 2016, doi: 10.17261/pressacademia.2016321991.

[11] Y. A. Kokoh, "Forensic Accounting: The Pertinence Of Benford's Law In Fraud Detection (Finance Sector Companies Listed On Indonesia Stock Exchange From 2009 To 2018)," Binus University, 2020.