International
Journal of
Management
& Organizational
Studies

Volume 5, Issue 2, June, 2016 **ISSN: 2305-2600**

Application of First Digits 'Benford' Law: A Case Study of an Indonesian Company

Teguh Sugiarto

Author(s) Biography

Teguh Sugiarto is a Doctoral Student at Brawijaya University and Lecturer Accounting at Budi Luhur Jakarta Indonesia

ABSTRACT: *This research was conducted by the authors to see how Benford Law, a Mathematical phenomenon that provides a unique method of data analysis, enables to see any deviations that indicate the possibility of error and fraud in the concept of bias manipulative or processing efficiency. Accountants and auditors have begun to apply the law of Benford's many enterprise data to find anomalies pattern number. Some websites frequency appears to state that the application of Benford's Law can predict for the observed frequencies of the numbers in the first digits and can establish fraud in this case on the financial statements of PT Timah (Persero) Tbk for financial statements ending in 2006-2010 , of the research that has been done can be concluded that the method Benford law is able to analyze the possibility of a fraud in the financial statements.*

Keywords: Benford law, First digits, Indonesia

Many methods of probability and statistics can give us how a modern analysis process that has the ability to cope with uncertainty in terms of reporting. Such methods are believed to have enough power is amazing to improve the accuracy of decision-making and to test new ideas in the work of an auditor. In the method of probability and statistics it make sure there is an amazing application, which is considered the author can highlight the depth or get unexpected results. This study is aimed primarily at financial auditors and IT auditors, where the method of mathematical statistics and can explore a lot of amazing applications, making them a better model. Probability law as Test Bad tests used to detect such things as attendance report abuse, accounting, finance and other large-scale model of data that often leads to a life-changing situation including termination of employment. In this study the authors fewer think that the test is in use a slightly inaccurate, but it seems also a little bit in the further study. This study discusses why a good test can provide results that are also good.

One set of data that can simply large or many, can be made as a tool in Decision Making Everyone in trust for teamwork in particular. Here the author tries to bring out of this intention that is by presenting a large-scale meeting earlier data with a method that is accurate enough and has been tested in many countries. Probability and statistical methods in use will later be able to give a lot of light on how to set up the decision-making either in person or group. In a paradox Simpsons - When the data that have a fairly large scale, then the rules are well received and practical over the data that is owned, but the more reliable are the conclusions given. Value of paradox Simpson was going to be able to slam the hammer on the rules and the result is an agreement that is better or worse than the realityin Malcom, W.B. (1998) [1] and Alvarez et, al (2008) [2].

By using the numbers 1 to 9 and the possibility of obtaining a random one of these numbers, regarded as the first digit in the number is 1/9. The possibility of the emergence of opportunities the numbers 1 through 9 will be able to work well for the data, if there is data on the falsified by embezzlers, but on the assumption that real data on the opportunities that much different. An economist suggested in 1906 was named Vilfredo Pareto of Italy, trying to apply this method on one of the major cases of the wealth differences between rich and poor as a result of capitalist greed or could it be a natural process like that. His name Benford's [3] Law that if we can extend to these and other questions about the data concerning the subject of ratings. This law is in a sense can resolve and make a breakthrough unprecedented in-depth problem-solving strategies as well as powerful, which can be used to de-bug software, troubleshoot the equipment and solve problems in business and industry in large data scale. By doing steps and enhance simulation Simulation - Monte Carlo consume large amounts of random numbers but it was nice to find something that is considered difficult to find.

LITERATURE REVIEW

Fifty years before Frank Benford Benford law explains the law, Newcomb has provided a theoretical explanation for the phenomenon in his article that describes logarithmic almost unnoticed by many people. It was only after 50 years later, independent of the original article published Newcomb. A physicist named Frank Benford noticed that the first few pages of logarithm books more worn than some earlier models. In Benford (1938) [3] and Newcomb (1881) [4] has a similar opinion about the subject premises Newcomb numbers starting with numbers lower than high. Benford argue that there are some numbers that begin with the lower digits. Benford analysis to test hypotheses and collected more than 20,000 sets of observations such as the area of the river, the atomic weights of elements, and the numbers appear in the Reader's Digest article. Similar to Ley, E. (1996) [5], Brady, H.E. (2005) [6]. which gives a conclusion that is convincing evidence that Benford method can be manipulated by their round-off errors to obtain a match in a logarithmic law, as described in Hill (1995) [7]. In Raimi (1976) [8]. a lot of mathematicians and statisticians who offered various explanations for this phenomenon. In this thesis Skousen et al (2004) [9],and Tam Cho et al (2007) [10]. concluded that there is a phenomenon be the result of "the way we write numbers,". While in Fisher, R.A. (1948) [11]. argues that Benford's law reflects something deep "harmonics" of a truth of nature. Hill (1995) [7]. argues that the distribution contained in Benford law, such as the normal distribution is observed empirical phenomena. Hill's argument relies on the fact that the numbers in the set are in accordance with the distribution of the second generation Benford distribution, a combination of other distributions. In the Mebane, Walter. (2007) [12]. and Hill, T.P (1996) [13]. if there is a distribution that is selected at random and random samples are taken from each of these distributions, the significant digits combined frequency of sampling will gather for the distribution of Benford's law.

According to Hesman (1999) [14]., Berber and Scacco's (2008) [15]. theory of Benford this conclusion, it is on combining figures from different sources, by combining a number of unrelated gives the distribution of

distribution. In the law of randomness is true that there is a universal. Hesman, Berber and Scacco believes that if there is a possibility of fraud, the perpetrator will be prosecuted, and it is quite impossible. In Camerer (2003) [16]., which conducts research using data test secondary trying to disguise their actions - as well as Berber and Scacco who give the conclusion that if the offender entering what they consider to be random or in other words the presence of an increase in the number in the official tally, experimental evidence indicates that rewriting rarely number more than what we expected from chance. As with the Levin et al (2009) [17].who found the test application is fitting for the election of a suspect, so that the elections are carried should be free from fraud, occurs tenth of the time, and it makes sense to suspect protocol falsified if the observed frequencies are in significant.

More details, see Hill, T.P (1998) [18], Janvresse, et al (2004) [19]., and Mebane (2006) [20]. the justification offered for the relevance of the findings that collects the numbers resulting from random processes are different and will not be correlated within the limits of Benford's Law. Other empirical evidence in Berber and Scacco who conducted the analysis the last digit and the next-to-last, which found no corresponding behavior or theoretical reason to suppose that the first and second digit of the data contained on election fraud and falsified the sampling protocol. In Mebane and Walter (2008) [21], Nigrini (1996) [22], Nigrini and Mittermaier, (1997) [23]. and Ijiri et. al. (1977) [24] conducted a simulation using appropriate data dab shaped 2BL that indicated there is no reason to believe that fraud-free data it self will be in accordance with 2BL or even fraud that can not move the official data more closely in line with the law of Benford's.

RESEARCH METHOD

Data and Time of Research

Research conducted by the authors using financial statement data of PT Timah (Persero) Tbk listed on the Indonesia Stock Exchange started the year ended 2006-2010. The author conducting this study in February 2016.

Data Analysis Technique

The stages or steps to the data analysis done by the authors is as follows:

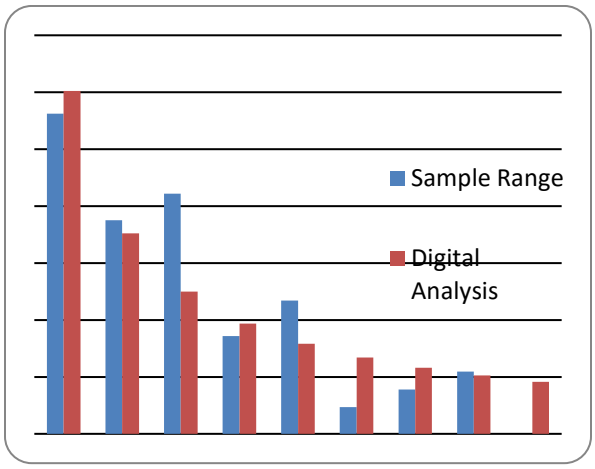
1. Analyze data with "Benford Analysis" from the Tools menu to open the tool. A line graph will appear showing typical Benford's Law distribution curve in yellow.
2. Source Table. Click the Browse button to see the project on the computer and select the table you want in the analysis.
3. 3. Once the selected table column, select the column name from the drop-down menu. The data in this column will be analyzed to determine the distribution of first digits.
4. 4. Digit. By default, this extension will only analyze the first digit of the number. However, if we want a better resolution, then we can increase the number of digits to analyze. For example, if we would choose the 2-digit numbers will be analyzed 10-99, instead of 1 to 9 for the analysis of a single digit.
5. 5. Graphics. If we had chosen each of the parameters that we have, just click the button Charts and graphs on the screen it will be processed. The results of the data we have will appear as a blue line in the chart alongside Benford's law distribution In Myagkov, et, al. (2009) [25] modifified author.

Table 3 : Result Benford law for the year ended 2007

Nomor	Range	Sample Range	Digital Analysis
1	36	28,1%	30,1%
2	24	18,8%	17,6%
3	27	21,1%	12,5%
4	11	8,6%	9,7%
5	15	11,7%	7,9%
6	3	2,3%	6,7%
7	5	3,9%	5,8%
8	7	5,5%	5,1%
9	0	0,0%	4,6%
Sub	**128**	**100,00%**	**100,00%**

Sources : Porceed by author

Figure 2 : Result Benford law Diagram for the year ended 2007



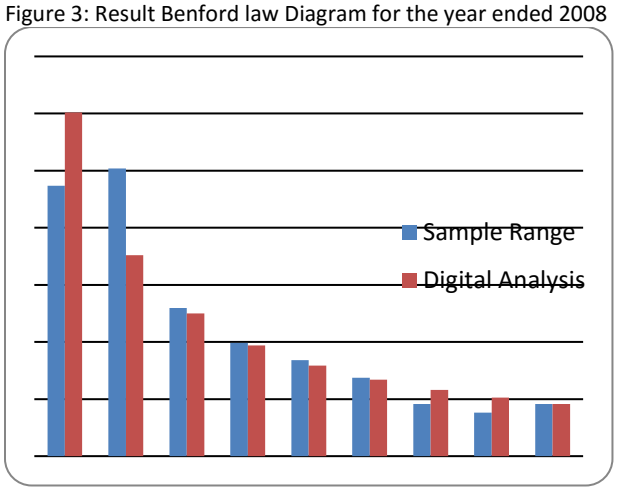
Sources : Porceed by author

Table 4 : Result Benford law for the year ended 2008

Nomor	Range	Sample Range	Digital Analysis
1	31	23,7%	30,1%
2	33	25,2%	17,6%
3	17	13,0%	12,5%
4	13	9,9%	9,7%
5	11	8,4%	7,9%
6	9	6,9%	6,7%
7	6	4,6%	5,8%
8	5	3,8%	5,1%
9	6	4,6%	4,6%
Sub	**131**	**100,00%**	**100,00%**

Sources : Proceed by author

Figure 3: Result Benford law Diagram for the year ended 2008



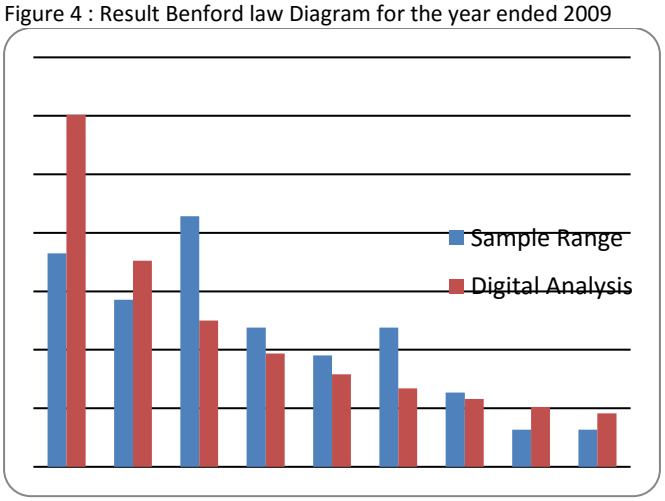
Sources : Proceed by author

Table 5 : Result Benford law for the year ended 2009

Nomor	Range	Sample Range	Digital Analysis
1	23	18,3%	30,1%
2	18	14,3%	17,6%
3	27	21,4%	12,5%
4	15	11,9%	9,7%
5	12	9,5%	7,9%
6	15	11,9%	6,7%
7	8	6,3%	5,8%
8	4	3,2%	5,1%
9	4	3,2%	4,6%
Sub	**126**	**100,00%**	**100,00%**

Sources : Porceed by author

Figure 4 : Result Benford law Diagram for the year ended 2009



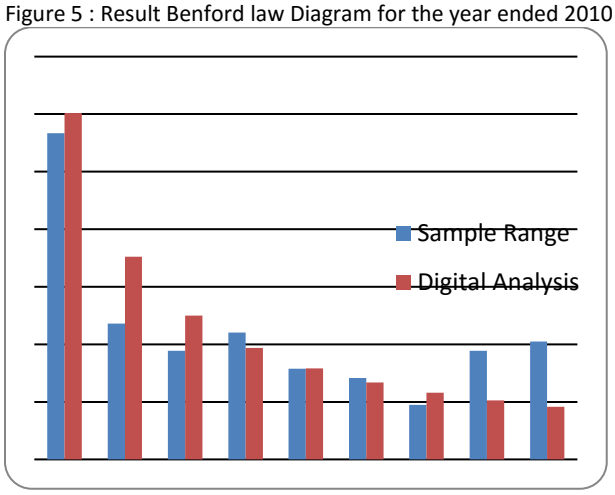
Sources : Porceed by author

Table 6 : Result Benford law for the year ended 2010

Nomor	Range	Sample Range	Digital Analysis
1	36	28,3%	30,1%
2	15	11,8%	17,6%
3	12	9,4%	12,5%
4	14	11,0%	9,7%
5	10	7,9%	7,9%
6	9	7,1%	6,7%
7	6	4,7%	5,8%
8	12	9,4%	5,1%
9	13	10,2%	4,6%
Sub	**127**	**100,00%**	**100,00%**

Sources : Porceed by author

Figure 5 : Result Benford law Diagram for the year ended 2010



Sources : Porceed by author

According to Mark J. Nigrini, Benford's Law author of the Depression-era physicist who calculated the expected frequency of the numbers in the list of other numbers begin with one than the other digit, followed by those who started with two, then three and so on. "The low numbers are expected to occur much more frequently than high numbers,". But according to Benford's Law, which must take into account 30% of the leading figures, and each consecutive numbers should represent the smaller proportion, with nine coming last, below 5%. From the output in [Table 1] [Table 2], [Table 3] [Table 4] [Table 5] until [Figure 1], [Figure 2], [Figure 3], [Figure 4], [Figure 5], with a possible difference in the furthest distance ranges between 1% -5%. While the results of tables and figures seen in the year in doing it analyzes the presence of the difference in the application of the law of Benford existing ranges above 5%, occurred in 2006 in number 2, 2007 at number 3, 2008 in figures 1 and 2 years 2009 in figures 1 and 3, and in 2010 the number 2. it is projected that the difference in distance between the methods Benford law with an estimate over the range of 5%, because the author considers the upper limit and lower limit in the range of 5% is enough to provide analysis advanced in the process of a fraud in the financial statements.

CONCLUSION

From the research that has been done can be concluded that if we are going to analyze large amounts of data to look for or find anomalies of potential fraud, the use of digital analysis techniques can be done. With this law Benford analysis techniques we would easily be able to find anomalies in the data that we have the report in accordance with the law benfor. How visible the results of research that has been done from a table view and there is a bar chart on the results of research and discussion.

REFERENCES

[1] Malcolm W. Browne. (1998)., "Following Benford's Law, or Looking Out for No. 1", By (From The New York Times, Tuesday, August 4, T. P. Hill, ,"The First-Digit Phenomenon" , American Scientist, July-August.

[2] Alvarez, R. Michael, Thad E. Hall and Susan D. Hyde. 2008. Election Fraud: Detecting and Deterring Electoral Manipulation. Washington D.C.: Brookings

[3] Benford, F. (1938), "The Law of Anomalous Numbers," Proceedings of the American Philosophical Society, 78, 551–572.

[4] Newcomb S (1881) Note on the frequency of use of the different digits in natural numbers. American Journal of Mathematics 4:39-40

[5] Ley E (1996) On the peculiar distribution of the U.S. stock indexes' digits. The American Statistician 50:311-313.

[6] Brady, Henry E. (2005). "Comments on Benford s Law and the Venezuelan Election." Unpublished manuscript, Stanford University, January 19, 2005.

[7] Hill, T.P, (1995). The significant digit Phenomenon. American Mathematical Monthly 102, April, (April) 102, pp. 332-327.

[8] Raimi, R. (1976) The First Digit Problem.,American Mathematical Monthly 83 (Aug.Sept.): 521538,.

[9] Skousen, C., Guan, L., & Wetzel, T. (2004). Anomalies and unusual patterns in reported earnings: Japanese managers round earnings. Journal of International Financial Management and Accounting, 15, 212-234.

[10] Tam Cho, W., & Gaines, B. (2007). Breaking the (Benford) law: Statistical fraud detection in campaign finance. American Statistician, 61, 218-223.

[11] Fisher, R.A., 1948. Answer to question 14 on combining independent tests of significance. Am. Stat. 2 (30).

[12] Mebane, Walter. (2007). "Election Forensics: Statistics, Recounts and Fraud," paper presented at the 2007 Annual Meeting of the Midwest Political Science Assn, Chicago, Il., April 12-16

[13] Hill, T.P, (1996). A Statical Derivation of the sgnificant- Digit Law. Statistical Sience,4, pp. 354-363.

[14] Hesman, T., (1999). Cheaters tripped up by random numbers law [Entrevista] (22 March 2016).

[15] Berber, Bernd and Alexandra Scacco. 2008. "What the Numbers Say: A Digit Based Test for Election Fraud Using New Data from Nigeria," paper presented at

the Annual Meeting of the American Political Science Association, Boston Ma., August 28- 31.
[16] Camerer, Colin. (2003). Behavioral Game Theory: Experiments in Strategic Interaction. Princeton: Princeton University Press.
[17] Levin, Ines, Gabe A. Cohn, R. Michael Alvarez and Peter C. Ordeshook. (2009). Detecting Voter Fraud in an Electronic Voting Context: An Analysis of the Unlimited Reelection Vote in Venezuela. Electronic Voting Technology Workshop / Workshop on Trustworthy Elections, Online Proceedings
[18] Hill, T.P. (1998). "The First-Digit Phenomenon," American Scientist, July-August
[19] Janvresse, Élise and Thierry de la Rue. 2004. "From Uniform Distributions to Benford's Law." Journal of Applied Probability 41"1203-1210.
[20] Mebane, Walter. (2006). "Election Forensics: Vote Counts and Benford's Law." Paper prepared for the 2006 Summer Meeting of the Political Methodology Society, UC-Davis, July 20-22.
[21] Mebane, Walter. (2008). "Election Forensics: The Second Digit Benford's Law Test and Recent American Presidential Elections," in R.M. Alvarez, T.E. Hall and S.D. Hyde, Election Fraud, Washington D.C.: Brookings.
[22] M. J. Nigrini, (1996).,Using Digital Frequencies to Detect Fraud , The White Paper (April/May): 36.
[23] M. J. Nigrini and L. I. Mittermaier, (1997). The Use of Benford's Law as an Aid in Analytical Procedures , Auditing: A Journal of Practice and Theory 16 (Fall): 5267.
[24] Ijiri, Yuri and Herbert Simon. (1977). Skew Distributions and the Sizes of Business Firms, N.Y.: North Holland Pub.
[25] Myagkov, Mikhail, Peter C. Ordeshook and Dimitri Shakin. (2009). The Forensics of Election Fraud. Cambridge: Cambridge University Press
Additional website :
[26] http://www.journalofaccountancy.com/issues/1999/may/nigrini.html#sthash.tdcDzM4Y.dpuf
[27] https://plus.maths.org/content/looking-out-number-one
[28] http://www.rexswain.com/benford.html
[29] http://www.kirix.com/extensions/benfords-law-and-fraud-detection-analysis/
[30] http://www.intuitor.com/statistics/index.html
[31] http://www.journalofaccountancy.com/issues/1999/may/nigrini.html#sthash.tdcDzM4Y.dpuf