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[Field Research]

Benford's Law and its Application in Auditing

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Abstract

Purpose – Benford's Law is a simple and effective auditor tool that detects fraud. This paper's purpose is to audit the efficiency of Benford's law, which uses a set of strange observations, certain numbers repeated over other numbers in the data set.

Research design, data, and methodology – Benford's law was applied in numerical analysis. We can say that in addition to reducing the duration of the audit, the capacities of the audit were more robust.

Results – Sample auditse valuated the ability of auditors to prove fraud and expand the use of analytical procedures in planning the audit. Additionally, the use of the analyses as part of the computer's internal controls helped to further improve the effectiveness of internal controls and reinforce them.

Conclusions – Benford analysis should be carried out as appropriate .In subsequent studies, it can also be examined as a tool to reveal doubtful accounts. Numerical analysis of the data and a computer are necessary. Programs for data analysis in various applications such as auditing (SAS) and (ACL) and (Case Ware) and (IDEA) are available.

Keywords: Benford's Law, Numerical Analysis, Auditing, Internal Controls.

JEL Classifications: D30, E40, E50.

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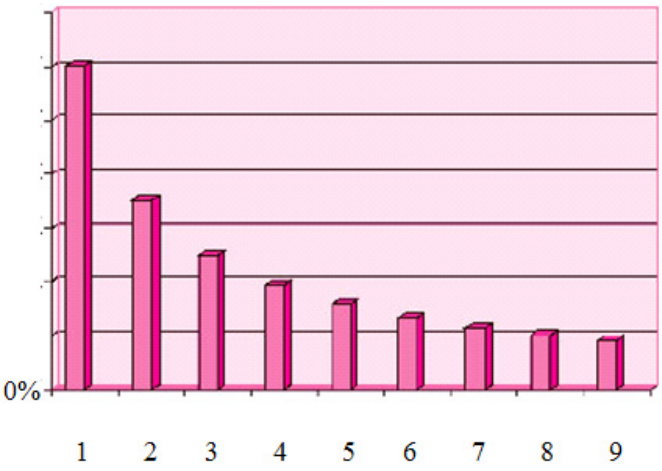
1. Introduction

In the seventeenth century, astronomers, mathematicians, sociologists and other scholars because they were not yet invented a computer and a calculator for computing the log from the log books in the library used. in this book, to show the results of logarithmic tables were considered significant. scientists, by moving your fingers on the screen, built-response obtained. Benford their claims in various fields by a large number of statistical data, through the new Relationship compotes tested. by Frank Benford obtained results indicate that the years he has spent much of the data collected. new compotes, it is likely that a number of non-zero integer number comes at the beginning of a mathematical equation was calculated from the following: P (d) = log10 (1 + 1 / d) (1) d = 1,2,3,4,5,6,7,8,9 For example, according to the new relationship compotes, the probability that at one go figure 2, is equal to: P(2) = log10 (1 + 1/2) = 0/176090.

Benford findings therefore, the probability that the first significant digit is 1, 30.1 percent, figure 2, 17.6 percent, and the probability that the first significant digit 9 is only about 4.5 percent. In 1996, Ted Hill (Ted Hill) mathematics professor at Georgia institute of technology atlanta, in a paper published in the journal statistical science, mathematics, and through the use of the central limit theorem proved Benford's law. hill also prove Benford's law, the impact on the outcome scale distributed data also showed. for example, if the scale of a group of data riyals, according to Benford distribution change if the dollar or the euro, there is no impact on the outcome of this law. in addition,

Ted Hill, new equation compotes inserting extended hybrid varieties: P(d1 d2 d3 ... dk) = log10[1+ (1 / d1 d2 d3 ... dk)] (2).for example, the probability that one starts with the digits 314, the (Hill, 1998):P (314) = log10 [1+ (1/314)] = 0/0014 .therefore, in the analysis, along with the first test, the laboratory tests, such as the second, the first two or last two digits if it complies with Benford's law can be generalized. for example, the number 147 contains three digits. in the first place the figure 1, figure 4on the second place and third place in number is 7 digits. as the above table shows, according to Benford's

law distribution with the expected number 1 in the first the number starts with 30/103% and the expected distribution of the third digit number that starts with the digit 7 equal to 9/902 percent (Nigrini, 1996).



<Figure 1> A significant percentage figure in the first digit of a number

2. Usenumerical analysis

When an auditor numerical analysis in order to detect possible fraud in the collection of data generation should have a few things in mind (Durtschi et al., 2004):

1. on which type of data is expected to be effective analytical Benford analysis? the audit should be conducted before the numerical analysis, analysis of data sets are intended to consider Benford's law. in other words, do not expect a specific data sets are analyzed with Benford distribution or not?
2. what tests should be conducted to analyze the data and how to interpret the results?
3. when numerical are ineffective analysis? in other words, the numerical analysis of the data that is cheating, do not sign?
4. the auditor's ability to succeed in numerical analysis depends on how much you can get help from Benford's law to recognize and handle suspicious accounts administered to take a closer?

<Table 1> Percentage distribution expected in each of the figures 0 to 9 in each of the first and fourth positions of the numbers.

Standing figures				
	First	Second	Third	Fourth
0		11.9680	10.1780	10.0180
1	30.1030	11.3890	10.1380	10.0140
2	17.6090	10.8820	10.0970	10.100
3	12.4940	10.4330	10.0570	10.0070
4	6.6910	10.0310	10.0180	1.0021
5	7.9180	9.6680	9.9790	9.9880
6	6.6950	9.3370	9.9500	9.9941
7	5.7990	9.351	9.9021	9.9910
8	5.1150	8.7571	9.8641	9.9861
9	4.5760	8.6000	9.8270	9.9821

3. Specifications for the effectiveness of Benford's Law

Benford distribution is expected to comply with the accounting data and thus are a good candidate for numerical analysis (Hill, 1996). in general, the effectiveness of Benford's law in numerical analysis should consider the following (Durtschi et al., 2004):1. the accounts formed from the combination of mathematical figures, examples are appropriate for this analysis. for example, accounts receivable refers to the product of the number of items sold in the price of each item. it is expected that the majority of accounts payable and expense and income are distributed according to Benford distribution.2. In general, the possibility of relying on the results of the analysis is that instead of choosing a small sample Benford when more than one account, select the account. this is due to the choice of a greater amount of data, the results of the analysis show correctly.3. when the data values into ascending order, we will continue these figures should mainly as a geometric gradient. for example, a numerical analysis on various accounts of a large medical center by, Halysn & Pajyny was conducted, it was observed that the cost of the laboratory does not conform to Benford distribution, while none of indirect Reasonably well in the absence of imperfection. further investigations revealed that the cause duplicate transactions that statistical tests fail, especially there are several purchases amounted to US $ 11/40, which was related to the amount of liquid nitrogen by skin doctors was ordered. the various purchases amounting to US $ 34/95 were related to the prices of bottled water. when these items were excluded, the data were consistent with the expected distribution.

4. Situations of non-use of Benford's Law

1. the code numbers such as the number of checks, ID number, zip codes and phone numbers because they are distributed with a certain code or numbers that are affected by mental phenomena such as the price of goods and services or to withdraw

cash from ATM machines, obey Benford's law. encoded numbers from a uniform distribution over obey Benford distribution. most prices are also influenced by psychological barriers; for example 1/99 shows that less than $ 2 dollars, so prices tend to be under psychiatric prices. withdrawals from ATMs are also pre-defined modes at any time to pay fixed amounts (Nigrini & Mittermaier, 1997).2. data should be limited from above and from below. the ceiling and floor are not pre-defined. for example, accounts that certain amounts paid to all employees (including transportation costs, meals, etc.) do not follow Benford's law. Benford's Lawdoes not apply to certain employees of insurance costs because the insurer has set a ceiling set for it. thus, the law limits the data will be bounded (Benford, 1938).3 other accounts that are not expected to follow Benford distribution, are those that are made from the highest and lowest prices. for example, account before signing up to a level that should reach a certain value, it is possible that the numbers are made with the highest and lowest prices of the Benford distribution does not follow (Nigrini,1996).4. it is impossible to prove theft and bribery with Benford's law (Durtschi et al., 2004).Since 1940, more than 150 scientific research has been done on Benford's law. according to research by Gilles (2005) of the department of economics, university of victoria, 11, the top figures in professional football leagues ticket sales prices of follow Benford's law (Giles, 2005).In another study by (Li,2004) was conducted, it was found that the fibonacciseries 12, a census of the population and the figures contained in the paper, follow Benford distribution (Zhipeng et al., 2004). Benford's law, especially in the light of its application has not been audited. according to one study found that Iranian companies because of mental phenomena 199 USD, feel free to manage its net profit by rounding towards high net profit figure. in this study, the Benford distribution as the distribution of the expected profit for the second digit to the left, is used. the aim of this study was to answer the question of whether the observed distribution of digits as the second digit to the left of the sample firms, with the expected distribution based on Benford's law or not (Simon, 1881).

5. Using Benford's Law on Audit

The actual distribution figures discrepancy with the expected distribution according to Benford's law, showing the influence of an external factor. the intentional manipulation of financial data indicates cluttered the normal distribution of data. So the Benford's law and accounting data connection is established. Nigriny accounting Nigrini(1999), the existence of financial fraud in the accounting data is realized by means of the law. He has to prove this, a lot of samples collected financial and statistical tests are very quick follow Benford's law revealed. his thesis is defended itself by relying on the law (Nigrini, 1999).failures recent audit followed by a statement No. 99 board auditing standards 13, association of certified public accountants America 14, entitled "consideration of fraud in the audit of financial statements", which in 2002 released the audit profession's position that the analytical tools audit procedures to detect fraud and a new search. one of these analytical tools, using Benford's law (Nigrini, 2012).

6. Interpretation of results Benford

According to Benford's law, when deciding on the effectiveness of the numerical analysis, two points should be borne in mind. first, whatever the size of the data entered is low, the impact of numerical analysis, and the second is that in most cases there are accounts with the distribution Benford choice did not match, however, will be counterfeit. like other statistical tests, the analysis of this finding Benford carefully compared with the expected results and possible deviations calculated. for example, the Benford distribution of expected numbers 1 begins with the first digit is equal to 30/103. Because they are strictly complied with any of the data is not expected, so little difference in the distribution of the observed with the expected distribution will be acceptable. the expected distribution of the data in one place, according to Benford's law is a logarithmic distribution and chi-square distribution is markedly similar. statistically, significant deviations from the normal distribution is the distribution amount and the deviation, the diagnosis according to whether or not the data will be distributed Benford(Durtschi, 2004).auditor two hypotheses H0 (data obey Benford distribution) and H1 (data obey Benford distribution) defines. then, using the chi-square test, calculates the amount of the contribution of error. after considering the contribution of the error and degrees of freedom (here df = 9-1 = 8), the amount corresponding to the table to find the square. to determine whether the observed difference is statistically significant or not, it is necessary to determine the level of significance. if the test statistic is in the critical chi-square value obtained from the amount set forth in the table more the greater the deviation between the two distributions and hypothesis H0 is rejected. on the other hand, whatever the calculated chi-square value is less than the corresponding value in the table, the hypothesis H0 is rejected and can't be accepted. in other words, in case of rejection of H0 auditor to the possibility of error or fraud is suspected data their audit focuses on subjects related to these numbers. for example, if the actual distribution of numbers beginning with the digit 5 with the expected Benford distribution according to the number of test Chi-square deviation, is there evidence that these numbers are, they will scrutiny (Benford, 1938).

$\chi 2 = (Ei - Oi)\ 2 / Ei$ (3)

Ei = true frequencies

Oi = theoretical frequencies

today, these calculations have to be done very fast computer programs and only the auditor the results of the audit areas that should more accurately be determined.

7. Conclusion

Benford analysis should be carried out as appropriate, in subsequent studies also reveal doubtful accounts, will become a useful tool. using numerical analysis of the data, you need to use the computer. Programs for data analysis in various applications such as auditing (SAS) and (ACL) and (Case Ware) and (IDEA) are available. numerical analysis on a knowledge of Benford's law and some professional judgment to determine the anomaly needs. the purpose of the application of Benford's Law in numerical analysis, increasing the ability of auditors to prove fraud and expanding the use of analytical procedures in planning the audit by the auditors. in addition, the use of such analyzes as part of the computer's internal controls help to improve further the effectiveness of internal controls and reinforce it. on the other hand, some experts also likely that some users who have access to information on the implementation of this analysis their destructive goals, necessary reforms are carried out and the noble act of analysis. note also that in the end it is necessary to look at the effect of Benford's law audit, we can say that in addition to reducing the duration of the audit, the capacities the audit also provides a new form of power.

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