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Numbers Don't Lie: Decoding Financial Error and Fraud through Benford's Law

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ABSTRACT

This research investigates Benford's Law as a statistical instrument to detect financial fraud and errors. Benford's Law, also known as the First-Digit Law, states that lesser digits, specifically '1', frequently appear as the leading digit in numerous numerical datasets, and deviations from this distribution may indicate potential financial irregularities. This research examines literature demonstrating the application and efficacy of Benford's Law in identifying numerical inconsistencies indicative of financial misconduct. This research investigates the use of Benford's Law as a tool of detecting error and fraudulent activities within the sales data of two branches during 2022. A comprehensive dataset of 3098 records from Bandung and 539 records from Surabaya was collected after excluding certain data points that exhibited abnormalities. The application of Benford's statistical test discovered a discrepancy between the Benford probability and the observed probability, suggesting the presence of possible errors and frauds. The audit findings unveiled anomalies in pricing and instances of fraudulent activities in both locations, primarily due to pricing discrepancies and incorrect price inputs from sales orders. Furthermore, instances of fraud involved the manipulation of set prices for personal gain by salesmen. The results affirmed the hypothesis that a larger deviation between Benford's probability and the observed probability corresponded with a higher incidence of error and fraud. However, it observes that Benford's Law is not a stand-alone solution for detecting fraud, as not all financial datasets conform to it and deviations from the law only indicate the possibility of fraud, not confirm it. Therefore, the research suggests using Benford's Law in conjunction with other data analysis and auditing techniques to conduct a comprehensive investigation. The conclusion of research emphasizes the significance of Benford's Law in the field of forensic accounting and the need for multidimensional strategies for effective error and fraud detection.

Keywords: *Audit Systems, Benford's Law, Errors, Fraud*

INTRODUCTION

Financial errors and fraud pose significant challenges to the accuracy and reliability of financial information. The identification and mitigation of such errors and fraudulent actions are importance in upholding confidence in financial systems and safeguarding the accuracy and reliability of financial reporting. In recent years, scholars and professionals have increasingly utilized creative methodologies to detect and analyze instances of financial irregularities. One strategy that can be employed is the utilization of Benford's Law, which provides a statistical framework for examining the distribution of numerical values in financial data with the aim of detecting possible inaccuracies and fraudulent activities. Benford's Law is one of the methods often used by auditors and academics in computer-based audit (Setyawan, 2020). Moreover, Benford's law is very useful in terms of detecting irregularities in financial statements (Gorenc, 2019).

Benford's Law, also known as the First-Digit Law, is a mathematical principle that reveals a distinct pattern in the distribution of initial digits in naturally occurring datasets. It was discovered in the late 19th century. This principle states that smaller numbers, especially '1', appear as the leading digit approximately 30% of the time, followed by diminishing frequencies for digits 2 through 9. Throughout the years, this initially unexpected result has been utilized as a potent instrument in numerous disciplines, including fraud detection and forensic accounting. Deviation from the anticipated distribution can serve as an indication of abnormalities or probable fraudulent activities inside the dataset. According to SAS 107, AU Sec 312 about risk analysis, SAS 111, AU Sec 350 of the sample approach, and SAS 99, AU Sec 316 relating the requirements of fraud, Benford's law will assist effective audit quality and efficiency in identifying fraud (Antonio, 2014).

The utilization of Benford's Law in the identification of financial errors and fraudulent activities has garnered significant interest owing to its capacity to uncover abnormalities that could otherwise evade detection through conventional approaches. Moreover, Benford's distribution is very simple to calculate, is scale-independent and fits every currency (Grammatikos & Papanikolaou, 2021). Through the process of comparing the empirical distribution of initial digits in financial data with the anticipated distribution as outlined by Benford's Law, individuals such as auditors, investigators, and researchers have the ability to discern discernible patterns that could potentially signify errors or instances of fraudulent behavior. This methodology has the potential to be highly advantageous in the identification of financial statement fraud, because the deliberate alteration or misrepresentation of data can lead to a distortion in the numerical distribution. Moreover, Benford's law is an efficient digital analysis technology that divided into three levels: applicability verification, anomaly data detection, and cross application with other methods (Li et al., 2019).

Numerous empirical investigations have substantiated the efficacy of Benford's Law in the identification and detection of financial inaccuracies and fraudulent activities. For instance, the research by Aggarwal & Dharni (2020), found that there is a significant difference in conformance to Benford's Law

between shell companies and genuine companies. Through the utilization of statistical analysis and probability theory, Benford's Law offers a quantitative framework that facilitates the identification of probable errors and fraudulent activities. This framework empowers auditors and investigators to concentrate their efforts on specific areas that necessitate additional investigation.

Nevertheless, it is imperative to recognize the inherent restrictions and obstacles that arise when applying Benford's Law. The efficacy of this methodology hinges upon the underlying assumption that the data under examination adheres to a natural distribution. Furthermore, it is important to note that the suitability of Benford's Law for different businesses or data sets can differ, necessitating thorough examination and verification.

This study's primary objective is to investigate Benford's Law's application in detecting financial errors and frauds. By analyzing the expected distribution of leading numerals, this statistical tool can identify anomalies and patterns indicative of fraudulent activity in financial datasets. This study seeks to establish a comprehensive comprehension of Benford's Law, its mathematical underpinnings, and its potential role in mitigating financial error and fraud risks.

The scope of this research paper is to illustrate and validate the practical use of Benford's Law in decoding financial errors and detecting fraud in a real-world scenario. The research focuses on two actual sales datasets from a distributor company in the fast-moving consumer goods (FMCG) industry, specifically from its Bandung and Surabaya branches for the year 2022. Data collection is a crucial step in this research, as the accuracy and reliability of the datasets directly influence the results. The two sales datasets from Bandung and Surabaya branches are gathered and examined for data attribute completeness and data broken. After preparing the data, the research applies the Benford Statistical Test using Microsoft Excel software to analyze the digit distributions in the datasets.

Interpretation of the Benford Test results is a key aspect of the research. The effectiveness of Benford's Law is assessed by conducting an audit on a sample of 10% from each first-digit category. The audit involves a manual check on the accuracy of the data, including calculations, tax rates, and pricing, as well as compliance with Standard Operating Procedures. The findings from the audit are then analyzed to determine the potential of Benford's Law in detecting errors and fraud. The research scope also includes a discussion on the factors contributing to the errors and fraud detected through the Benford Test. Pricing errors and incorrect inputs in sales orders manually created by salesmen are identified as the main error factors. Moreover, fraudulent activities are found to be related to salesmen manipulating set prices for personal interests in collaboration with sales administration.

LITERATURE REVIEW

Benford's Law and Error and Fraud Detection

The utility of Benford's Law in detecting error and fraud is based on the assumption that legitimate financial data should conform to Benford's distribution.

In contrast, fabricated or manipulated figures are likely to deviate from this pattern. For example, a manager attempting to inflate a company's revenues or decrease its expenses may fabricate figures that do not adhere to Benford's Law. In a number of instances, this technique has successfully uncovered fraudulent activities, such as the infamous Enron scandal, which involved widespread accounting fraud.

Despite the fact that Benford's Law is a beneficial starting point for detecting fraud and errors, it is by no means a silver bullet. This law will not apply to all financial datasets. Deviations may occur for valid reasons, including certain corporate policies or industry standards. Minor deviations sometimes had an effect on data quality and subject safety (Ghooi et al., 2016). Therefore, a deviation from Benford's Law should be interpreted as a red flag, requiring additional investigation, rather than as conclusive evidence of fraud or error. For example, auditors and forensic accountants should employ Benford's Law as part of a broader inventory of fraud detection techniques. This may involve the use of sophisticated data analytics, in-depth reviews of accounting records, and interviews and surveys to corroborate suspicions of fraudulent activity or accounting errors.

Application in Error Detection

Benford's Law is a useful method for finding errors in numerical datasets, especially in accounting and financial records (Gorenc, 2019). Auditors can compare the actual distribution of initial digits to the distribution predicted by Benford's Law while examining financial transactions. If the observed distribution deviates significantly from the predicted pattern, there may be data mistakes. These errors could be the consequence of incorrect data entry, transposition, or other factors. The starting digits in a financial statement, for instance, may be overrepresented or underrepresented, resulting in an unnatural digit distribution. Such departures from the expected trend serve as indicators that demand additional research.

RESEARCH METHODOLOGY

Application in Detecting Fraud

Fraud can be identified by manipulation, falsification or alteration of records and or documents to modify asset, liability, and capital records, misappropriation of assets, reduction or omission of transactions in accounting records, unproven transaction logs, and inappropriate accounting applications (Antonio, 2022). The use of Benford's Law extends to the identification of financial data fraud. Moreover, the probability of digits in the first four positions of a number are defined by Benford's law (Tammaru & Alver, 2016). It resembles the idea of materiality in quantitative audits. Intentional number manipulation is a common component of fraudulent transactions used to cover up unlawful activity or poor money management. As a result, fraudulent datasets digit distributions may considerably diverge from the pattern foreseen by Benford's Law. Data collection, data preparation, statistical analysis, and interpretation are the four main processes in putting Benford's Law into practise.

1. Data gathering
   The first stage is to gather the data set to which Benford's Law will be applied. This information could include anything from the financial operations of a firm to city population estimates to election vote totals. It's crucial to keep in mind that the dataset must cover several orders of magnitude, be scale invariant (i.e., the pattern remains the same if you change units), and not have a predetermined minimum or maximum.
2. Preparing Data
   After it has been gathered, the data must be ready for analysis. Since zeros do not contribute to the distribution of leading digits and missing values can skew the study, this entails deleting any rows with missing or zero values.
3. Statistical Examine
   The following step is doing a statistical analysis to contrast the observed distribution of initial digits in your data with the anticipated distribution in accordance with Benford's Law.

The objective of this job is to analyse and evaluate the similarities and differences between the frequencies of leading digits that are actually seen in a specific dataset and the frequencies that would be expected based on certain assumptions. The Chi-square test can be employed to determine the existence of a statistically significant discrepancy between the observed and expected distributions. The chi-square statistic is utilized as a measure for quantifying the difference between the observed frequencies of leading digits in a specific dataset and the expected frequencies outlined by Benford's Law. As the magnitude of this value grows, the discrepancy between the observed and expected frequencies also amplifies. Nevertheless, using only the chi-square statistic is inadequate for assessing the conformity of data to Benford's Law. Additionally, it is imperative to take into account the degrees of freedom, which, in this particular circumstance, often amount to 8. This is attributed to the existence of nine potential leading numbers, spanning from 1 to 9.

The utilization of degrees of freedom is essential for determining the critical value of the chi-square distribution, which in turn enables the calculation of the p-value. The p-value is the probability of observing a chi-square statistic that is as extreme as, or more extreme than, the computed value, assuming that the null hypothesis is true. In the current context, the null hypothesis postulates that the observed data conform to Benford's Law. When the estimated p-value is less than the preset significance level, typically set at 0.05 or 5%, the null hypothesis is rejected. This implies that the observed data does not conform to Benford's Law. The aforementioned discovery suggests the existence of abnormalities within the dataset, which may be attributable to instances of manipulation or fraudulent activity. Conversely, if the calculated p-value surpasses the set level of significance, the null hypothesis would not be rejected. This suggests that the existing evidence is inadequate to substantiate the claim that the data deviates greatly from Benford's Law.

Benford's Law must be rigorously observed for there to be no indication of fraud or error. Significant departures from the predicted distribution, however, may indicate data anomalies, fraud, or errors. It's crucial to remember, though, that a departure from Benford's Law does not necessarily indicate fraud. It only presents a question that needs more research. Significant deviations from the expected distribution may be indicative of fraudulent or erroneous behavior. For instance, if a company's financial data indicate that '9' is the primary digit significantly more frequently than Benford's Law predicts, it could be an indication that the company is inflating its numbers to meet financial goals. In this way, Benford's Law serves as a red flag system, signaling potential areas of concern that require further investigation. It is essential to know that a deviation from Benford's Law is not, in and of itself, evidence of fraud.

Due to particular business practices or industry standards, it is conceivable for valid datasets to deviate from Benford's Law. The distribution of the data's digits can be compared to the theoretical distribution of Benford's Law to identify fraudulent activity in accounting data (Renaldo et al., 2022). To illustrate and validate the practical use of Benford's Law, a realistic dataset is crucial. Therefore, two actual sales datasets are used in this paper. The dataset is the sales data from two branches, specifically Bandung and Surabaya, for the year 2022. The data pertains to a distributor company in the fast-moving consumer goods (FMCG) industry. The Bandung branch starts operations in 2021, while the Surabaya branch begins operations in the subsequent year, 2022. For the operation, all data sales are inputted to the Point-of-sale software based on the Microsoft SQL Server database.

The Process of Collecting Data

The data that has been gathered pertains to the sales figures for the year 2022, from Bandung and Surabaya. The data is extracted from the Microsoft SQL Server Database. The sales data for the year 2022 reveal that Bandung has a total of 3098 records, while Surabaya has 539 records.

Preparing Data

Data is examined for data attribute completeness and data broken. From the audit, no data broken was found, but it was discovered that there are 4 data that have a sale price of 0 at the Bandung branch and 2 data points that have a sale price of 0 at the Surabaya branch. These 6 data points were deleted; thus, they were not tested using Benford's Test. The final data tested using Benford's Test were 3098 records for Bandung and 539 records for Surabaya.

FINDING AND DISCUSSION

Benford Statistical Test-Sales Data-Bandung

Data processing is running by using Microsoft Excel software. The results of the data processing are as follows:

Table 1. Benford Tests - Sales Data 2022 – Bandung

Benford Tests - Sales Data 2022 – Bandung					
Digit	**Number**	**Benford Probability**	**Observed Probability**	**Deviation**	**Chi-Square Value**
1	932	30,1	30,08	0,02	0,000
2	542	17,61	17,5	0,11	0,023
3	390	12,49	12,59	-0,1	0,022
4	327	9,69	10,56	-0,87	2,387
5	235	7,92	7,59	0,33	0,433
6	196	6,69	6,33	0,36	0,627
7	179	5,8	5,78	0,02	0,002
8	158	5,12	5,1	0,02	0,001
9	139	4,58	4,49	0,09	0,054
	3098				**3,550**
		Critical Threshold for Chi-Square Tests 95% (8 degrees of freedom)			**15,507**

Source: Processed Data by Researcher (2022)

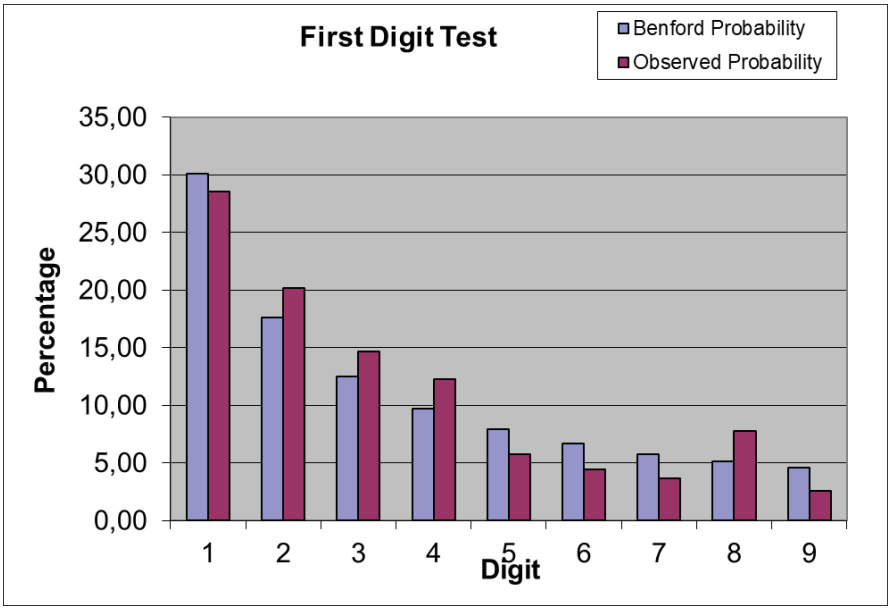

Figure 1. First Digit Test – Bandung – Sales Data 2022

The Benford test conducted on sales data from 2022 in Bandung showed a Chi-Square value of 3.550, which is much smaller than its critical threshold of 15.507. This suggests the null hypothesis failed to be rejected, which indicates the 2022 sales data of the Bandung branch follows Benford's Law. The data following Benford's Law showed no abnormalities. If no abnormalities were found, then it is

expected that no errors or fraud were found. The smallest deviation between the observed probability and the Benford probability is shown by the first digits 1, 7, and 9, and the largest deviation is at the first digits 4.5 and 6. The first digit 4 shows the largest Chi-Square number, well above the Chi-Square value of the other first digit. To prove whether this Benford's Law hypothesis was true, a manual audit was carried out to prove that there were no errors or fraud.

Benford Statistical Test – Sales Data 2022 – Bandung

Data processing is running by using Microsoft Excel software. The results of the data processing are as follows:

Table 2. Benford Tests - Sales Data 2022 – Surabaya

Benford Tests - Sales Data 2022 – Surabaya					
Digit	**Number**	**Benford Probability**	**Observed Probability**	**Deviation**	**Chi-Square Value**
1	134	30,1	28,57	1,53	4,920
2	109	17,61	20,22	-2,61	2,091
3	79	12,49	14,66	-2,17	2,018
4	66	9,69	12,24	-2,55	3,628
5	31	7,92	5,75	2,17	3,196
6	24	6,69	4,45	2,24	4,047
7	20	5,8	3,71	2,09	4,055
8	62	5,12	7,79	-2,67	42,992
9	14	4,58	2,6	1,98	4,610
	539				**71,557**
		Critical Thresholds for Chi-Square Tests 95% (8 degrees of freedom)			**15,507**

Source: Processed Data by Researcher (2022)

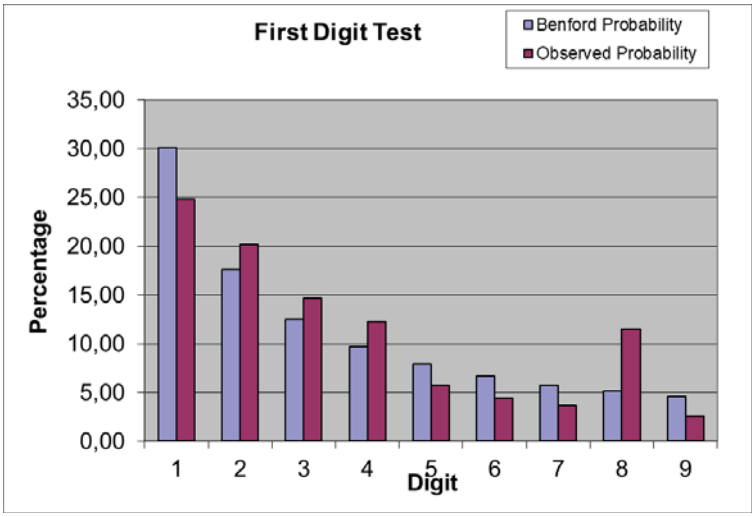

Figure 2. First Digit Test –Surabaya – Sales Data 2022

The Benford test carried out on sales data for 2022 in Surabaya showed a Chi-Square value of 71.507, which is much greater than its critical threshold value of

15.507. This suggests the null hypothesis was rejected, which indicates the 2022 sales data of the Surabaya branch did not follow Benford's Law. Data that doesn't follow Benford's Law indicates abnormalities. If he finds abnormalities, then there are indications for errors and fraud. The smallest deviation between the observed probability and the Benford probability is shown by the first digits 2 and 3, and the largest deviation is at the first digits 8, 1, 9, and 6. First digit 8 shows the largest Chi-Square number, far above the Chi-Square value of the other first digit. To prove whether this Benford's Law hypothesis was true, a manual audit was performed to prove whether there were errors and fraud as indicated by the Benford test.

Audit Manual – Sales Data 2022 – Bandung

In determining the effectiveness of Benford's Law, an audit is performed by taking a sample of 10% from each first-digit category and conducting a manual check on the accuracy of the data (sales quantity, sales price and calculation). The sampled data taken is as follows:

Table 3. Sample of Sales Data 2022 - Bandung

Digit	Bandung	
	Records	Sample 10%
1	932	94
2	542	55
3	390	39
4	327	33
5	235	24
6	196	20
7	179	18
8	158	16
9	139	14
Total	**3098**	**313**

Source: Processed Data by Researcher (2022)

Sample data taken for Bandung was 313 records. The audit is carried out by taking random samples of each first-digit category, as many as there are determined in the table 2. For the first digit 1, sample taken is 94 records and for the first digit 2 sample taken is 55 records etc. Data taken as a sample is chosen randomly by excel and traced to related documents for manual checks on the accuracy of the sales quantity, sales price and calculation. The results of the examination are as shown by table 4. The business process in sales starts with the creation of a sales order by a salesman. The sales order, which is on paper, is inputted into the Point of Sales software by the sales administration and the sales order will be archived according to the sequence of the sales order number. Once the sales order is created, a delivery note is made, and after the delivery note is sent, an invoice is issued.

Table 4. Audit Findings – Sales Data 2022 – Bandung

Digit	Bandung	
	Errors	Frauds
1	1	0
2	0	0
3	0	0
4	2	1
5	0	0
6	1	0
7	0	0
8	0	0
9	0	0
Total	**4**	**1**

The manual audit process is carried out by tracing the invoice to the source document, which is the sales order, and matching the sales quantity listed on the invoice with the sales quantity on the manual sales order. Another check is performed on the sales price to compare it with the sales price listed on the sales order, as well as recalculating the multiplication of the sales order quantity and sales price compared to the total amount on the manual sales order.

In the first digit 1, one error was found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, transposition errors occurred, the price that should have been Rp. 88,378.97 was inputted into the system at IDR 88,387.97.

In the first digit 4, two errors were found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, transposition errors occurred, the price that should have been IDR 69,197.73 was inputted into the system at IDR 69,917.73 and 150,243.24 was inputted as 150,234.24. In the first digit 6, one error was found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, transcription errors occurred, the price that should have been IDR 65,472.95 was inputted into the system at IDR 65,472.5.

In the first digit 4, one fraud was discovered through the method of giving a sales price to the customer far below the sales price that should have been set. After confirming with the customer to charge for the shortfall in money due to the price mistake, the customer stated that he had given a sum of money to the salesman. This fraud was done by one salesman only.

Audit Manual of Sales Data 2022 in Surabaya

To determine the effectiveness of Benford's Law, an audit is performed by taking a sample of 10% from each first-digit category and conducting a manual check on the accuracy of the data (sales quantity, sales price and calculation). The sampled data taken is as follows:

Table 5. Sample of Sales Data 2022 - Surabaya

Digit	Surabaya	
	Records	Sample 10%
1	134	14
2	109	11
3	79	8
4	66	7
5	31	4
6	24	3
7	20	2
8	62	7
9	14	2
Total	**539**	**58**

Source: Processed Data by Researcher (2022)

Sample data taken at Surabaya was 58 records. The audit is carried out by taking random samples of each first-digit category, as many as there are determined in the table 5. For the first digit 1, sample taken is 14 records and for the first digit 2 sample taken is 11 records etc. Data taken as a sample is chosen randomly by excel and traced to related documents for manual checks on the accuracy of the sales quantity, sales price and calculation. The results of the examination are as follows:

Table 6. Audit Findings – Sales Data 2022 – Surabaya

Digit	Surabaya	
	Errors	Frauds
1	3	1
2	2	1
3	1	0
4	1	0
5	0	0
6	0	1
7	0	0
8	1	1
9	0	0
Total	**8**	**4**

Source: Processed Data by Researcher (2022)

The business process in sales starts with the creation of a sales order by a salesman. The sales order, which is on paper, is inputted into the Point of Sales software by the sales administration and the sales order will be archived according

to the sequence of the sales order number. Once the sales order is created, a delivery note is made, and after the delivery note is sent, an invoice is issued.

The manual audit process is carried out by tracing the invoice to the source document, which is the sales order, and matching the sales quantity listed on the invoice with the sales quantity on the manual sales order. Another check is performed on the sales price to compare it with the sales price listed on the sales order, as well as recalculating the multiplication of the sales order quantity and sales price compared to the total amount on the manual sales order.

In the first digit 1, three errors were found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, two transposition errors occurred, the price that should have been IDR 77.395,50 was inputted into the system at IDR 77.935,50 and IDR 81.162.16 was inputted into the system at IDR 81.126.16. One more error cause by incorrect input of price, the price in sales order is IDR 93.775,49 but inputted as IDR 93.777,49

In the first digit 2, two errors were found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, two transposition errors occurred, the price that should have been IDR 58.149 was inputted into the system at IDR 58.419 and IDR 78.727,29 was inputted into the system at IDR 78.727,92.

In the first digit 3, one error was found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, transcription errors occurred, the price that should have been IDR 45.450.80 was inputted into the system at IDR 45.405.80.

In the first digit 4, one error was found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, transposition errors occurred, the price that should have been IDR 79.889.46 was inputted into the system at IDR 79.898.46.

In the first digit 8, one error was found caused by incorrect price input. The price inputted accidentally differed from that on the sales order. In this case, transcription errors occurred, the price that should have been IDR 40.786 was inputted into the system at IDR 40.876.

In the first digit 1, one fraud was discovered through the method of giving a sales price to the customer far below the sales price that should have been set. After confirming with the customer to charge for the shortfall in money due to the price mistake, the customer stated that he had given a sum of money to the salesman.

In the first digit 2, one fraud was discovered through the method of giving a sales price to the customer far below the sales price that should have been set. After confirming with the customer to charge for the shortfall in money due to the price mistake, the customer stated that he had given a sum of money to the salesman.

In the first digit 6, one fraud was discovered through the method of giving a sales price to the customer far below the sales price that should have been set. After confirming with the customer to charge for the shortfall in money due to the price mistake, the customer stated that he had given a sum of money to the salesman.

In the first digit 8, one fraud was discovered through the method of giving a sales price to the customer far below the sales price that should have been set. After

confirming with the customer to charge for the shortfall in money due to the price mistake, the customer stated that he had given a sum of money to the salesman.

In total, on the Surabaya branch there are 4 frauds, 3 frauds by one salesman and 1 fraud by another salesman and involved 3 customers.

The majority error factors are explained by the incorrect input of price from sales orders that were manually created by salesmen. The majority of frauds were conducted by manipulating the set price for the personal interests of salesmen who collaborated with customers.

Table 7. Summaries - Benford Test Sales Data 2022 – All Branches

Digit	Bandung				Surabaya			
	Deviation	Chi-Square	Errors	Frauds	Deviation	Chi-Square	Errors	Frauds
1	0,02	0,000	1	0	1,53	4,920	3	1
2	0,11	0,023	0	0	-2,61	2,091	2	1
3	-0,1	0,022	0	0	-2,17	2,018	1	0
4	-0,87	2,387	2	1	-2,55	3,628	1	0
5	0,33	0,433	0	0	2,17	3,196	0	0
6	0,36	0,627	1	0	2,24	4,047	0	1
7	0,02	0,002	0	0	2,09	4,055	0	0
8	0,02	0,001	0	0	-2,67	42,992	1	1
9	0,09	0,054	0	0	1,98	4,610	0	0
Total	**-0,020**	**3,550**	**4**	**1**	**0,010**	**71,557**	**8**	**4**
Critical Threshold for Chi-Square Tests 95% (8 degrees of freedom) = 15,507								

Source: Processed Data by Researcher (2022)

The Benford branch test showed that the data followed the Benford's Law pattern with a Chi-Square Value of 3.550, which is well below the critical threshold for Chi-square Tests' 95% value of 15,507. Although following Benford's Law, five findings were found: four errors and one fraud, or 0.16% of the total 3098 data in 2022. Benford's Surabaya branch test showed that the data did not follow the Benford Law pattern with a chi-Square Value of 71.557, which is well above the 95% Critical Threshold for Chi-square Tests, which is 15,507. The manual results of the audit showed 12 findings, 8 errors, and 4 frauds, or 2.23% of the total data of 539 in 2022.

CONCLUSION

Based on these findings, it can be concluded that the higher the difference between the Benford probability and the observed probability, the larger the findings produced. This explains why the potential of Benford's Law in the domain of fraud detection is compelling. Its inherent simplicity and broad applicability provide a practical and efficient means of detecting anomalies that may signify financial error or fraud. However, it should be used as part of a comprehensive suite of forensic tools, supplemented by rigorous investigative procedures. The use of

Benford's Law in financial auditing and fraud detection approaches has been beneficial. While Benford's Law has shown promise in detecting financial fraud, it is not without limitations. One challenge is the need for a large dataset to ensure statistical significance. Additionally, certain types of fraud may not exhibit significant deviations from Benford's Law, making it less effective in those cases. Furthermore, the applicability of Benford's Law to scientific publications has been questioned, as the distribution of first digits in scientific data may not conform to the expected. The use of Benford's Law in financial fraud detection has the potential to enhance the effectiveness and efficiency of fraud detection processes. However, further research is needed to address the limitations and challenges associated with its application. Future studies could explore the combination of Benford's Law with other statistical and machine learning algorithms to improve fraud detection accuracy. Additionally, research could focus on developing automated tools and software that can analyze large datasets and flag potentially fraudulent activities based on Benford's Law. This might result in real-time fraud detection systems that continuously check financial data for irregularities and suspect patterns

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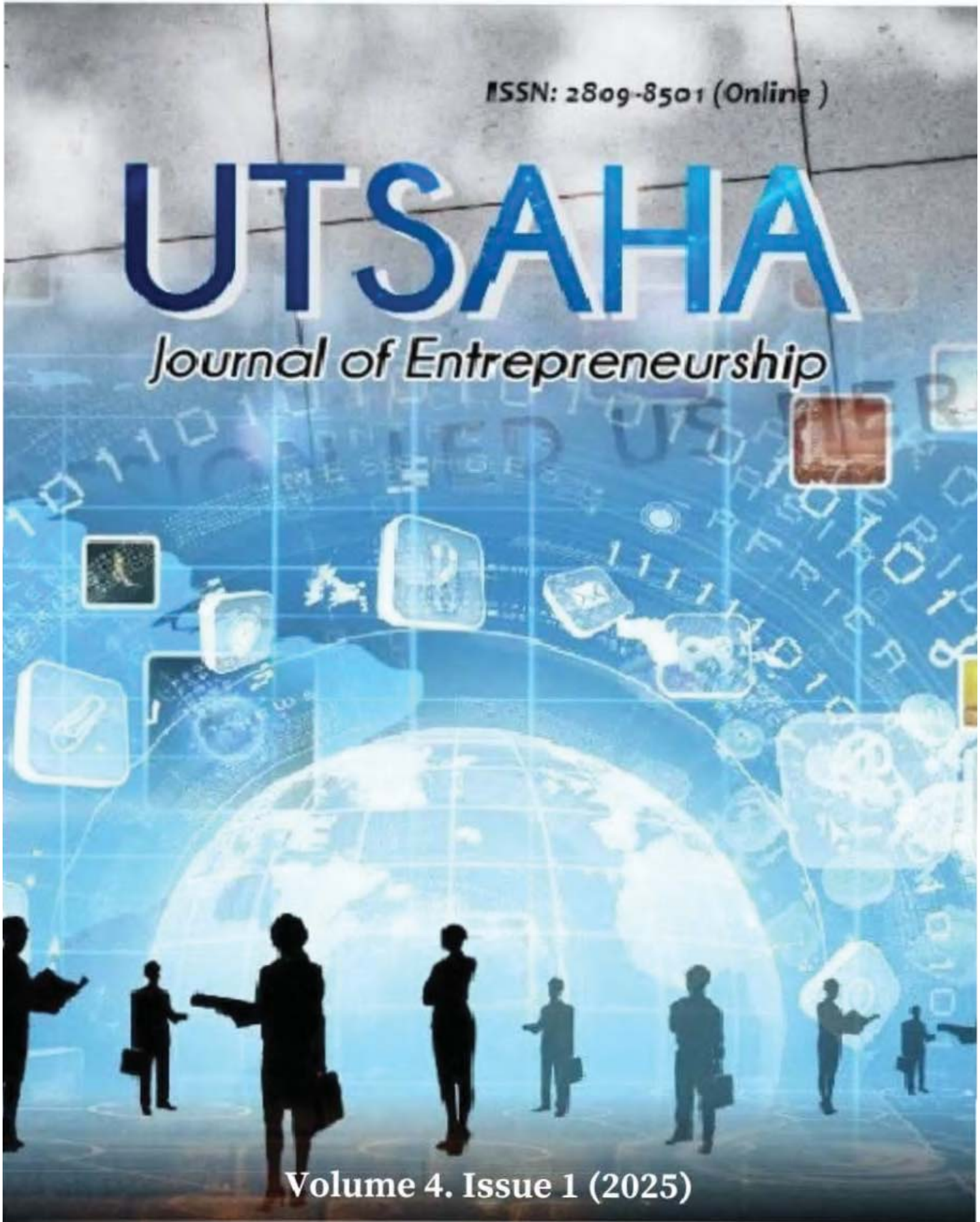

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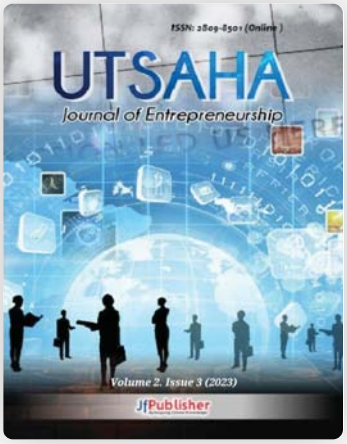

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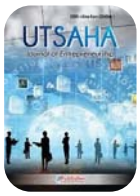

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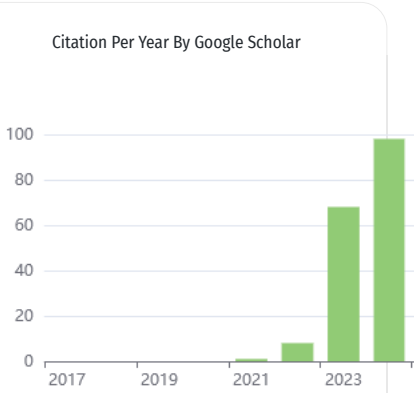

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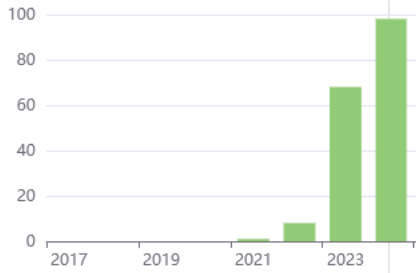

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