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The Implementation of Benford's Law to Detect Indications of Corruption Patterns in Government Institutions

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ABSTRACT

Disclosure of corruption cases requires a collaboration of experts in law, accounting, and auditing. In Indonesia's context, corruption patterns in government institutions can be identified based on the types of expenditure and the timing of cash disbursements. This study aims to reveal the indications and patterns of corruption in Indonesian government institutions. This study uses data on cash disbursements to detect indications and patterns of corruption. The first-digit, second-digits and first-two-digits digital analysis methods based on Benford's law were employed to analyze the data. This study found differences in cash disbursement transactions data value and Benford's law value. Furthermore, this study also discovers that corruption in government institutions follows a pattern in which corruptions often occur in the procurement of goods/services, purchases of food and beverage, and miscellaneous payments. The indications of corruption transpire throughout the year and show an increase at the end of the year (i.e., October to December), suggesting a 'year-end rush' and a phenomenon of 'hurry-up spending' in government institutions. Another pattern is related to digit groups of 30, 50, 60, and 90 committing corruption through cash disbursement transactions deliberately.

KEYWORDS:
Benford's Law; corruption; cash disbursement; year-end rush; hurry-up spending

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INTRODUCTION

Corruption is a worldwide phenomenon. While in some countries, corruption can be incidental, in other countries, it can be systematic and chronic (Prabowo, 2014). Corruption does not happen randomly. It has patterns, and corruptors are often a part of a patterned network (Indriati, 2014). Results of a fraud survey conducted by the Association of Certified Fraud Examiners (ACFE) Indonesia Chapter in 2019 concluded that the most detrimental fraud in Indonesia is corruption (70%), followed by abuse of state assets (21%), and fraudulent financial statement (9%). Given the previous, auditors should play a major role in disclosing corruption in Indonesia, given that internal auditors are disclosing only 23.4% of frauds. In comparison, disclosure of frauds by external auditors is only 9.6% (ACFE Indonesia Chapter, 2020).

The Indonesian government has developed a strategy for preventing and eradicating corruption. However, there are still problems, especially related to overlapping regulations, weak supervision and law enforcement, lack of integrity and professionalism of government employees, and low protection for whistleblowers and witnesses of corruption (Nugroho, Raharjo, & Pranoto, 2015). Several patterns of corruption have been identified by Juwono and Mayasari (2019) which include those related to licensing in mining, oil and gas, forestry, spatial and land sectors, legislative functions, procurement of public goods and services, job promotions, transfers, and bribery, as well as village funds as the most recent phenomenon.

Discussions on prevention, detection, and proof of corruption are the domain of forensic accounting. Singleton and Singleton (2010) explained that forensic accounting refers to a comprehensive view of fraud investigation. Forensic accounting is a formulation developed as a preventive, detective, and persuasive strategy for fraud by applying forensic audit procedures and investigative audits that provide litigation and non-litigation support (Singleton and Singleton, 2010). Uncovering systematic corruption and its patterns requires diverse expertise, including auditing, specifically investigative auditing. Types of corruption in Indonesia have been clearly defined by Law Number 31 of 1999 as amended by Law Number 20 of 2001 on the Eradication of Corruption. As defined by the preceding laws, there are 30 types of corruption divided into seven categories: causing losses to the nation, bribery, occupational embezzlement, extortion, deception, conflict of interests in the procurement of goods and services gratification (Prabowo, 2014). According to the 2018 database of the Corruption Eradication Commission (Komisi Pemberantasan Korupsi, KPK), there are five major patterns of corruption in Indonesia, notable procurement of goods and services, bribery, budget misappropriation, unauthorized collection, and licensing (KPK, 2018).

Systematic use of science-based investigative audit methods, combined with digital technology, will increase the probability of revealing indications and patterns of corruption. Benford's Law digital analysis is a widely used scientific method for uncovering the indications of minor and moderate-scale corruption (Kuruppu, 2019). It works to detect digits of abnormal transactions that violate Benford's Law and to statistically predict digit anomalies in financial data (Shein & Lanza, 2009). Benford's Law digital analysis has been proven to be effective in detecting anomalies in financial data that indicate corruption. In addition, it provides auditors with a simple and effective tool to detect fraud (Durtschi, Hillison, & Pacini, 2004).

Further investigations on data anomalies detected from Benford's law and followed by an investigative procedure will help reveal the corruption allegation. Tota, Aliaj, and Lamcja (2016) confirmed that Benford's Law could help detect cases involving fictitious figures or produce signals for further investigation. The use of Benford's Law digital analysis and how it works has been widely discussed in the literature but is rarely studied by legal practitioners (Lanham, 2019). Moreover, some financial professionals are often unaware of the ability of Benford's Law to detect fraud (Kuruppu, 2019).

This study involves cash disbursement transactions data from an Indonesian government institution to study the indications and patterns of corruption. There is a phenomenon of corruption in several types of cash disbursements which have high inherent risks. Another phenomenon is high cash expenditures at the end of the fiscal year, otherwise known as 'year-end rush' and 'hurry-up spending' (Wijaya, 2013; Douglas & Franklin, 2006), potentially contributing to corruption. However, Wijaya (2013) explained that the number of expenditures could not be the same for each month since the characteristic of expenditure for each budget item may vary. As an illustration, the complexity and lengthy procurement process of goods/services can create uncertainty in budget absorption. Such uncertainty can result in the year-end rush phenomenon.

The data used in this study have met Benford's law digital analysis requirements (Nigrini, 2012), which include the following:

1. Data must represent a measure of fact or event.
2. There are no minimum and maximum values in the data, except the acceptable minimum value of zero.
3. The data must not include numbers that are used as an identification number, such as telephone, bank account, and flight numbers;
4. The data should not be clustered around their average values.

Based on the phenomenon known as the 'year-end rush' and 'hurry-up spending', the research problems are presented as follows:

1. Is there any discrepancy in the cash disbursement transaction value from Benford's law value?
2. Are there any patterns of corruption for each type of cash disbursement?
3. Are there any indications of a higher pattern of corruption at the end of the fiscal year?

LITERATURE REVIEW

Benford's Law

Benford's Law was first introduced in 1881 by Newcomb (Lanham, 2019). Fifty years later, Frank Benford (1938) conducted his research titled "The Law of Anomaly Numbers," which observed more than 20,000 respondents in various fields. Benford's Law is a theory to predict the frequency of specific numbers in a data set. Benford's Law explains that the appearance of numbers that are not manipulated has its pattern. The frequency of occurrence of numbers in certain digits is not the same. Small numbers (such as numbers one or two) have a high frequency of occurrence compared to more significant numbers, or it can be concluded that the larger the number, the smaller the frequency of occurrence (Tota et al., 2016).

Mark J. Nigrini first used Benford's Law in 1996 to detect financial fraud or corruption, which concluded that if the data used did not contain manipulation or duplication, the resulting pattern would be the same as Benford's Law pattern. On the other hand, if the data used contain elements of manipulation or duplication, the resulting pattern will be different from Benford's Law. Nigrini (2012) argues that someone cheating or manipulating numbers will differ with the frequency of occurrence of numbers according to Benford's Law.

Benford's Law has several types of transaction data analysis, the first one being *the First Digit Analysis (First Digit Test)*. The first digit analysis is an analytical tool used to predict the frequency of numbers in the first digit in data. An example is that the number 1 in a data set can come from the first digit of the numbers 10, 100, 1000, and so on. The first digit analysis is used to provide a general description of the data to be used. First digit analysis is often used in observing how many numbers are in a data set. The difference in the frequency of numbers in the data set with the expected frequency of Benford's Law means indications of duplication and manipulation in the data. Such analysis will sometimes show a good level of conformity, even though data processing results have different patterns between the data used and Benford's Law (Nigrini, 2012). Bwarleling (2011) states that the first digit analysis can only detect fraud symptoms if the symptoms are apparent.

The Second Digit Analysis (Second Digit Test) is used to observe the frequency of numbers in the second digit of a number in a data set. For example, the number 12,000, then the number to be observed is the number of occurrences of the number two. The second digit analysis is usually used to determine whether there is rounding behavior in the data. The second digit analysis does not have a high accuracy in predicting fraud because it is a general analysis category. Differences in patterns are generally caused by the frequent rounding of numbers in the data set used (Shofy, 2016).

Lastly, *The First and Second Digit Combination Analysis (First-Two Digit Test)*. This test is used to predict the appearance of numbers in the first two digits. For example, the number 12,000 will be observed as the frequency of occurrence of the number 12. The First-Two Digit Test is more detailed in detecting the possibility of fraud and has better accuracy than the first and second-digit tests. The First-Two Digit Test can detect manipulations and deviations caused by using a number due to psychological factors or pressure from entity control (Nigrini, 2012).

The application of Benford's Law in auditing, according to Nigrini (2012), can be carried out for several types of tests. Nigrini (2012) identified five tests that can be used either proactively or reactively for fraudulent transactions, inefficiencies, rounded numbers, and duplicate payments. These digit tests include:

1. The first digit test
   The first digit test compares the actual first digit frequency distribution of a data set with that developed by Benford. The first and second digit tests are high-level tests designed to assess overall conformity and detect apparent anomalies. Because they are so high-level, these tests should not be used to select an audit sample.
2. The second digit test
   The second digit test is also a high-level test designed to test conformity or reasonableness. Remember that expected second digit proportions are less skewed than expected first digit proportions. Because this test results in a large sample selection, it should not be used to select audit samples. However, it can quickly identify potential problems in a data set, mainly if one assesses conformity using the Z- statistic.
3. The first two digits test
   The first two digits test combines the previous two tests and identifies manifested deviations that warrant further review. To that end, it can be used to select efficient audit samples for testing. The first two digits test, on the other hand, combines these two tests and identifies apparent deviations that need to be investigated

further. Therefore, it can be used to select efficient audit samples for testing.

4. The first three digits test
   The first three digits test is a highly focused test that is also used to select audit samples. While the first two digits test tends to indicate broad categories of abnormality, such as payments made just below an authorized limit, the first three digits test tends to identify unusual amounts that have been duplicated. The first three digits and last two-digit tests are also used to select audit samples. While the first two digits test tends to indicate broad categories of abnormality, such as payments made just below an authorized limit, the first three digits test tends to identify unusual amounts that have been duplicated.

5. The last two digits test
   The last two digits test is used to identify fabricated and rounded numbers. This test is convenient because all the fraud examiners might need to select audit targets in populations smaller than 10,000. Because the expected proportion of all possible last two-digit combinations is .01, it is easy to identify abnormalities via a graph. This test is beneficial if financial statement figures have been rounded, suggesting that the figures are estimates rather than actual amounts. Because this test results in small and efficient sample sizes, it can be used to identify patterns that might not be evident when using the previous four tests.

Some researchers have found similarities and differences in number patterns with Benford's Law. Durtschi et al. (2004) found that the first digit analysis of office supplies disbursement amounts yielded the same pattern as Benford's Law. The two numbers have differences but are not significant. However, on the other hand, the analysis of the first digit of the insurance refund check amount produces a different pattern from Benford's Law. There is only one number that has the same pattern. Likewise, research conducted by Bwarleling (2011) shows a similar pattern between the results of the data analysis used and the pattern of Benford's Law.

Support for the similarity of the test data pattern with Benford's Law is also provided by Kruruppu (2019), where the analysis of the first digit of the sales account has the same pattern as Benford's Law. However, the analysis of the first digit of the accounts receivable is different from that of Benford's Law. Prasetyo and Djufri (2020) used a z-test in the first digit analysis. Only three numbers did not have a significant difference, while the other numbers had a significant difference. The analysis of the second digit resulted in three numbers having no significant difference, while the other seven numbers had a significant difference. The analysis of the first two digits yields a similarity of 54.4%, while the remaining 45.6% has no similarity with Benford's Law. Cella and Zanolla (2018) identified discrepancies in the first and second digits through the application of Benford's Law. Research conducted by Arkan (2010) found differences in the pattern of first digit analysis between customs value data and Benford's Law, while the second digit test and the first two-digit test could not be proven. This finding is supported by Mujiono (2012), who suggests that the analysis of premium sales produces a different pattern, except for numbers one and three. The results of the diesel sales analysis have a relatively close pattern to Benford's Law. Tota et al. (2016), Shofy (2016), found that the first and second digit analyses pattern differs from Benford's Law. The analysis of the combination of the first and second digits has a discrepancy with the Benford's Law pattern in each account, including room sales by 26%, accounts receivable 33%, accounts payable 23%, and expense accounts having a difference of 21%.

Furthermore, Murhaban and Jufrizal (2017) argue that no pattern resembles Benford's Law pattern for analyzing the first, second, and third digits. Musriaddin, Abdullah and Asni (2018) complemented the results of previous research, which found a different pattern with Benford's Law using the mean absolute deviation (MAD) test. Of 86 samples, 48 did not follow Benford's Law, 28 had weak similarities, and nine samples showed strong similarities. Only one bears the closest resemblance to Benford's Law. Lanham's research (2019) shows that the analysis of the first digit has a different pattern with Benford's Law on number four. In contrast to the results of other research, Setyawan (2020) concludes that not all state expenditure data used can be analyzed.

Corruption

ACFE defines *fraud* as a deceptive act or mistake made by a person or entity, where the error can adversely impact individuals, entities, or other parties. The American Institute of Public Accountants (AICPA) has a slightly different definition stating that fraud is an act that violates the law and is carried out intentionally. The characteristic of fraud that distinguishes it from error is intentional (fraud) or unintentional (error) motivation. Statement of Auditing Standards (SAS) Number 99 defines *fraud* as a deliberate act to produce a material misstatement in the financial statements subject to the audit. According to the Indonesian Institute of Certified Public Accountants (IAPI), fraud is an act that aims to obtain a fraudulent or unlawful advantage, which is carried out by individuals or groups intentionally, both within management and outside management. If fraud is committed, there will be a harmed party because fraud is usually done by deceiving, hiding, or violating trust. Specifically, Law Number 20 of 2001 defines *corruption* as an unlawful act to enrich oneself or others, which results in state losses. This act of corruption is comitted by individuals who have the authority and position to enrich themselves and harm the state's interests.

ACFE (2016) classifies fraud into three main categories, known as the fraud tree, consisting of corruption, asset misappropriation, and financial statement fraud. Some unlawful acts in the corruption group are conflict of interest, bribery, illegal gratuities, and economic extortion. Other specific illegal actions that fall under the corruption group are accepting commissions, divulging organizational secrets in data or documents, and collusion in tenders. Asset misappropriation is the misuse of institutional assets, whether stolen or used for personal purposes, without the organization's permission. In comparison, financial statement fraud is the deliberate alteration of financial statements which does not reflect the actual financial condition. Financial statement fraud consists of net worth/net income overstatements and net worth/net income understatements.

Singleton and Singleton (2010) classify fraud, especially corruption, into several elements such as economic distortion, illegal gratuities, conflicts of interest, and bribery. Bribery falls into three categories: kickbacks, bid-rigging, and other types of bribery. Kickback is an unauthorized payment by a vendor to an officer or employee who influences the procurement of goods/services. In terms of fraud in the procurement of goods and services, Singleton and Singleton (2010) explained that tender collusion occurs when procurement officials or employees assist vendors in winning unfair contacts. U.S. General Services Administration (2012) affirms that corruption or fraud in the procurement of goods and services has indications of bid-rigging, collusion, inappropriate bidding prices, errors in charging costs, manipulation of products or services, bribery, kickbacks, and conflicts of interest.

RESEARCH METHOD

This study uses a quantitative method to answer the research questions. The empirical data were gathered from 28,004 cash disbursement transaction data from 2018 to 2020 obtained from Indonesian government institutions. The data consists of cash disbursements for goods/services procurement, food and beverage services purchases, subscriptions to power & services, salaries of non-permanent employees, business trips, vehicle fuel purchases, incentives, miscellaneous payments. The source of data is the financial transaction data submitted by the Auditor, which is confidential and limited. Therefore, according to the Government Auditor's Code of Ethics, the name of the Government Institution and details of the transaction being examined will be kept confidential. Schematically, the research framework is as shown in Figure 1. Digital analysis based on Benford's law is employed to undertake the following (Shein & Lanza, 2009):

1. Analysis of frequency patterns based on Benford's Law using three digital analyses: first-digits test (FD), second-digits test (SD), and first-two-digits test (F2D). In addition, Z-statistic and MAD are also used to measure the differences in the frequency patterns.
2. Digital analysis based on types of cash disbursement using the first-two-digits test (F2D), Z-statistic, MAD, duplications (DT), number frequency factor (NFF), and relative size factor (RSF).
3. Digital analysis based on the timing of cash disbursements using the First-Two-Digits test (F2D), Z-statistic, MAD, duplications (DT), NFF, and RSF.

MAD is used to test the accuracy of the forecast numbers by using the average absolute error value. If it produces a low error value, the actual proportion and the proportion from Benford's Law are reliable. The statistical Z test aims to test whether the proportions generated in the analysis of the first, second, and first two digits have a significant difference with Benford's Law.

The RSF test is the proper test to detect errors. Nigrini (2012) explains that the RSF identifies the largest number of occurrences of numbers in each analysis that does not match the number of occurrences of other

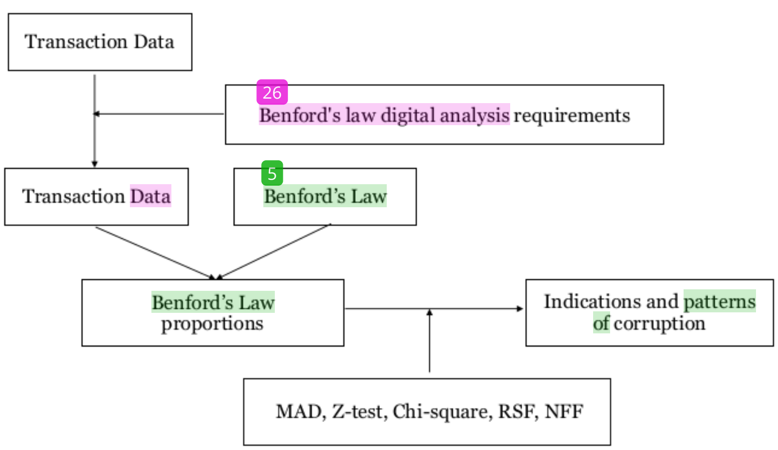

Figure 1. Research Framework (Nigiri, 2012)

numbers. The NFF test is used to measure the level of duplication in data. Nigrini (2012) developed the NFF test, which is used to identify duplication on tax returns. If the number of duplications is considered too much, there may be an indication of fraud or data duplication.

RESULT AND DISCUSSION

Analysis of Frequency Patterns Based on Benford's Law

Analysis of frequency patterns is carried out using the help of software ActiveData for Excel and Microsoft Excel for Windows, involving 28,004 cash disbursement transaction data from 2018 to 2020. This analysis aims to determine the similarity or difference in the frequency pattern of actual cash disbursement transactions data and the expected frequency according to Benford's law (Restianto & Bawono, 2011). The analysis is carried out by using three digital tests, i.e., first-digits test (FD), second-digits test (SD), and first-two-digits test (F2D). The magnitude of the difference between the actual and the expected value based on Benford's law is indicated by the Z-statistic value and the MAD.

First Digit Analysis

The first-digits analysis's objective is to detect a discrepancy found in the data with Benford's law. Although the first-digits test only generates a level of conformity with Benford's law, it is proved to be effective in detecting data anomalies (Nigrini, 2012). The results of the first-digits test can be seen in Table 1.

Table 1 shows that cash disbursement transaction value are not in accordance with Benford's value (N=28,000; Z-statistic>1.96; MAD=0.02129). The same result can also be observed visually from Figure 1. Based on Table 1 and Figure 2, the results show indications of corruption in all transaction values, including the transactions with the first digit of 1 to 9. In addition, cash disbursement transactions with the first digit of 1 and 9, totaling 8,321 data, are strongly suspected of having the largest indication of corruption.

Second-Digits Analysis

The second-digit analysis shows the same results as in the first-digit analysis. All cash disbursement transaction data are not in accordance with Benford's value (N=28.004; Z -statistic>1.96; MAD=0.05427). Transactions with the second digit of 0, 1, and 5 are strongly suspected of having the most signifi-

Table 1. First-Digits Test (FD) Results

Number	Amount of Data	Actual Value	Benford's Value	Z Statistic	Conclusion
1	6.122	0,21861	0,30103	30,05902	Nonconformity
2	4.775	0,17051	0,17609	2,44346	Nonconformity
3	3.839	0,13709	0,12494	6,13913	Nonconformity
4	2.492	0,08899	0,09691	4,47120	Nonconformity
5	2.728	0,09741	0,07918	11,28816	Nonconformity
6	2.285	0,08160	0,06695	9,79558	Nonconformity
7	1.919	0,06853	0,05799	7,52876	Nonconformity
8	1.641	0,05860	0,05115	5,64212	Nonconformity
9	2.199	0,07852	0,04576	26,22518	Nonconformity

cant indication of corruption. In sum, Table 2 and Figure 3 provide an overview of corruption indication in all transactions (i.e., transactions with the second digit of 0 to 9).

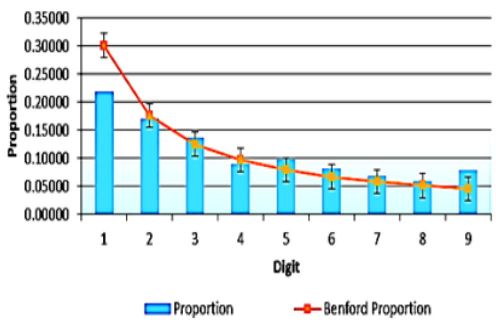

Figure 2. First-Digits Test (FD) Result

First-Two-Digits Analysis

The first-two-digit analysis result has a better accuracy level than the First- and Second-Digits analysis. The first two-digits analysis shows that almost all cash disbursement transaction data has a different pattern as Benford's law (N=28,000; MAD=0.00645). Of 90 digit-group data (i.e., first two digits of 10 to 99), 82 data significantly differ from Benford's law. The remainings (i.e., first two digits of 37, 52, 59, 84, 88, 87, 91, and 92) are in accordance with Benford's law (Z-statistic <1.96). Among 82 digit-group data that have significant differences with Benford's law,

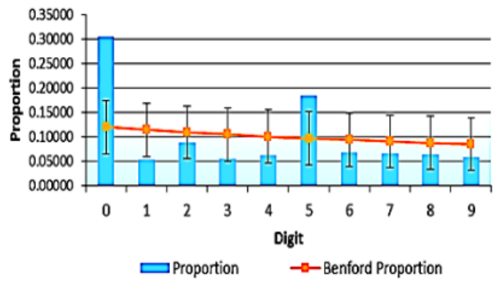

Figure 3. Second-Digits Test (SD) Results

those with the first two digits of 25, 30, 50, 60, 75, and 90 have a high degree of significant differences. These results indicate a pattern of corruption in cash disbursement transactions which involves digit-group of 25, 30, 50, 60, 75, and 90. Data on cash disbursements that are not in accordance with Benford's law can serve as preliminary indications of corruption. The first-two-digits test results are visually presented in Figure 4.

Digital Analysis Based on Types of Cash Disbursement

The first-two-digits test (F2D), Z-statistic, MAD, duplications (DT), NFF, and RSF are employed to detect data anomalies based on the type of cash disbursements. These tests aim at searching patterns of corruption indications in each type of cash disbursement. The data consist of 28,004 cash disburse-

Table 2. Second-Digits Test (SD) Results

Number	Amount of Data	Actual Value	Benford's Value	Z Statistic	Conclusion
0	8.495	0,30335	0,11968	94,68340	Nonconformity
1	1.486	0,05306	0,11389	32,03220	Nonconformity
2	2.440	0,08713	0,10882	11,64646	Nonconformity
3	1.532	0,05471	0,10433	27,15562	Nonconformity
4	1.720	0,06142	0,10031	21,65288	Nonconformity
5	5.163	0,18437	0,09668	49,64603	Nonconformity
6	1.869	0,06674	0,09337	15,30844	Nonconformity
7	1.850	0,06606	0,09035	14,16813	Nonconformity
8	1.803	0,06438	0,08757	13,71612	Nonconformity
9	1.646	0,05878	0,08500	15,72293	Nonconformity

ments transactions for the 2018 until 2020 period.

Results of the analysis, as summarized in Appendix 1, show that most of the transactions (78.4%) from each type of cash disbursements were not following Benford's law (MAD>0.0022). This indicates that corruption in cash disbursement transactions in government institutions is continuously up. Based on the type of cash disbursement, procurement of goods/services has the most significant indication of corruption, which is specified by a meager NFF value of 0.0046, the level of nonconformity with Benford's law of 74.9%, transaction duplication rate of and 10%, as well as a MAD value larger than 0.0022. In addition, a strong indication of fraud is found in transactions with the first two digits of 30, 50, 60, 70, 75, 80, 90, 98, and 99. Of the 6,610 transactions data related to goods/service procurement, 4,950 are indicated as deviations from Benford's Law.

As seen in Figure 5, data on the procurement of goods/services data shows a pattern in conformity with Benford's law. Furthermore, other types of expenditures that also indicate major fraud are purchases of food and beverage and miscellaneous payments as having a meager NFF value (0.0066), a nonconformance rate with Benford's law of 70.7%, MAD value larger than 0.0022, and transaction duplication rate of 8.3%. Similarly, data on miscellaneous payments also show a meager NFF value of 0.0073, a nonconformance rate with Benford's law of 88%, a MAD value larger than 0.0022, and a transaction duplication rate of 8.6%.

Another interesting pattern revealed from this analysis is that transactions with the first two digits of 30 and 50 show corruption in 10 and 8 types of cash disbursements, respectively. In conclusion, the indications of corruption in government institutions have a pattern. The pattern shows that corruption

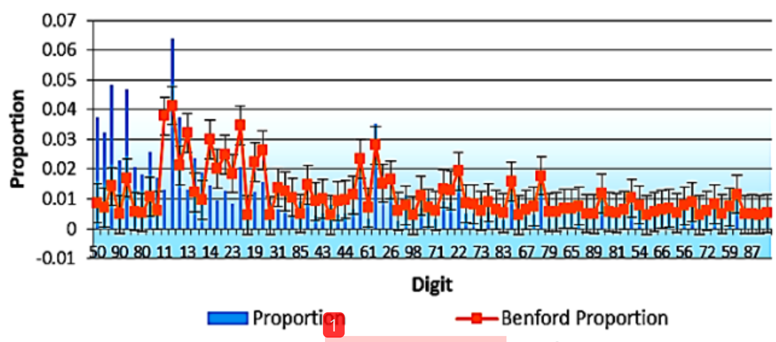

Figure 4. First-Two-Digits Test Result

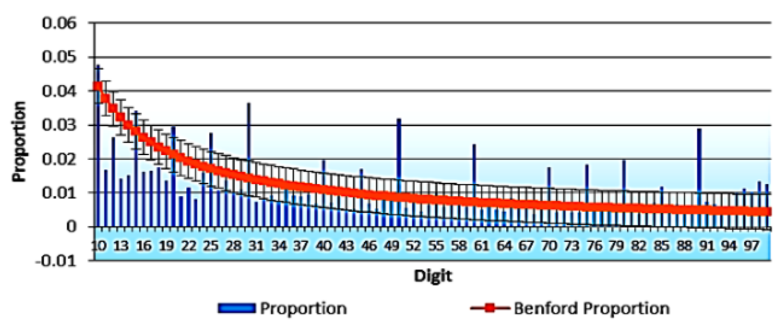

Figure 5. First-Two Digits Test Result for Goods/ Services Procurement

tends to occur in the procurement of goods/services, purchases of food and beverage, and miscellaneous payments. As these three types of transactions have high inherent risks, this finding may help explain. Not surprisingly, in practice, the digit groups of 30 and 50 tend to be used to make deliberate deviations.

Digital Analysis Based on Timing of Cash Disbursements

The first-two-digits test (F2D), Z-statistic, MAD, duplications (DT), number frequency factor (NFF), and relative size factor (RSF) are used to analyze data anomalies based on the timing of cash disbursements. The tests aim to figure out if the pattern of corruption recurs at certain times, particularly at the end of the fiscal year. In government institutions, there is a phenomenon that high cash outflows often occur at the end of the fiscal year, which is widely known as the 'year-end rush' and 'hurry-up spending.' The 'year-end rush' and 'hurry-up spending' usually transpire in the last quarter (i.e., October to December) and lead to corruption. Twenty-eight thousand and four cash disbursements transaction data from 2018 to 2020 carried out the analysis.

The results, as summarized in Appendix 2, demonstrate that most monthly cash disbursements (69.5%) conform with Benford's law (MAD value>0.0022). It indicates that corruption in cash disbursement transactions transpired throughout the year. However, to obtain more compelling evidence, more examinations are needed to draw a firm conclusion.

The results also found a large percentage of transaction discrepancies for October, November, December, which indicates a 'year-end rush' and 'hurry-up spending.' Transactions during October, November, April, and December have low NFF, implying a very high recurrence of transactions in the same digit group. The October transaction has the lowest NFF value (0.0194) and the MAD value of 0.0081, which show a nonconformance with Benford's Law (MAD value>0.0022). In addition, the nonconformance rate is 78.4%, and the transaction duplication rate reaches 9.4%.

A strong indication of corruption in the October transactions is found in the first two digits of 10, 25, 30, 35, 50, 60, and 90. Of the total 2,831 October transaction data, 2,220 transactions suggest irregularities. The conformity of October transaction data and Benford's law is also presented visually in Figure 6. For November data, transactions with the first two digits of 10, 25, 30, 35, 40, 50, 60, 75, and 90 have shown a strong indication of corruption. Of the total 4,112 November transaction data, 3,506 transactions display irregularities. From Figure 6, the discrepancy of November transaction data from Benford's Law.

A high indication of corruption is also detected in April transactions as ascertained by low NFF value (0.0136), the MAD value of 0.0073, which show conformity with Benford's Law (MAD value> 0.0022), nonconformance rate of 69,3% as well as transaction duplication rate of 10.9%. This result is presumably due to the new budget realization in April. Another result drawn from the April transaction data is that transactions with the first two digits of 60 and 50 show corruption within eleven months, while those with the first two digits of 90 and 30 demonstrate corruption in ten months. Overall, the pattern shows an occurrence of corruption in government institutions throughout the year and demonstrates an increase at the end of the year (i.e., from October to December). This signifies a 'year-end rush' and 'hurry-up spending' by government institutions. The digit group of 30, 50, 60, and 90 are often used to commit corruption for most of the fiscal year deliberately.

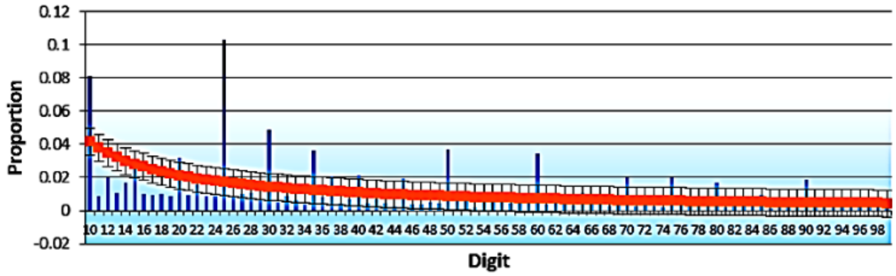

Figure 6. First-Two-Digits Test Results for October Transactions

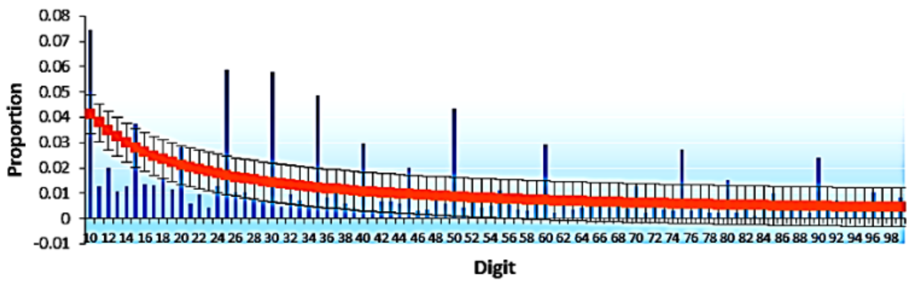

Figure 7. First-Two-Digits Test Results for November Transactions

CONCLUSION

The results show a disparity of the cash disbursement transaction value from Benford's law value. The first-digits, second-digits, and first-two digits test results found that almost all transactions have MAD values larger than 0.0022 and Z-statistics larger than 1.96. The result from the first-two-digits test demonstrates an indication of corruption in cash disbursement transactions with the first-two digits of 25, 30, 50, 60, 75, and 90. The patterns of corruption are found in transactions for goods/services, purchases of food and beverage, also miscellaneous payments. These three types of transactions naturally have a high inherent risk, resulting in a massive potential for irregularities. In addition, digits-groups of 30 and 50 are often used to commit corruption. Another pattern of corruption shows that indications of corruption in government institutions transpire throughout the year and show an increase at the end of the year (i.e., October to December). This signifies a 'year-end rush' and 'hurry-up spending' done by government institutions. Finally, another pattern reveals that groups of numbers 30, 50, 60, and 90 are indicated to be used to manipulate transactions at the end of the fiscal year.

Based on the study results, internal or external auditors in government institutions should disclose indications of corruption based on the patterns revealed in this study. Internal auditors are required to reveal whether indications of the pattern of corruption occur or not. Moreover, they need to focus on revealing corruption in cash disbursement activities, particularly the procurement of goods/services, food and beverage purchases, and miscellaneous payments. Government institutions must develop and implement sound internal control systems to reduce potential corruption within the procurement of goods/services, purchases of food and beverage, and miscellaneous payments. Internal and external auditors in government institutions are impelled to use digital analysis with Benford's Law approach to detect indications of corruption. Collaboration and synergy between law enforcement officials and forensic accountants or investigative auditors are imperative to uncover and prove corruption cases in government institutions in Indonesia. This study is only limited to cash disbursements transactions categorized based on the type of cash disbursements and the month of cash disbursements. Transactions are not grouped into suspicious and non-suspicious transactions. Future research is suggested to involve more government institutions, a larger sample of data with a longer timeline.

REFERENCES

ACFE. (2016). Report to the nations on occupational fraud and abuse. Retrieved from https://www.acfe.com/rttn2016/docs/2016-report-to-the-nations.pdf

ACFE Indonesia Chapter. (2020). *Survei fraud Indonesia 2019*. Jakarta: ACFE Indonesia Chapter. Retrieved from http://acfe-indonesia.or.id/wp-content/uploads/2017/07/SURVAI-FRAUD-INDONESIA-2016.pdf

Arkan, M. M. (2010). Analisis penggunaan Benford's Law dalam perencanaan audit pada Direktorat Jenderal Bea dan Cukai. *Simposium Nasional Akuntansi XIII*, 1–22.

Bwarleling, T. H. (2011). Pendeteksian fraud dengan hukum Benford. *Jurnal Akuntansi Bisnis*, *4*(2), 56–74.

Cella, R. S., & Zanolla, E. (2018). Benford's law and transparency: An analysis of municipal expenditure. *Brazilian Business Review, 15*(4), 331-347. DOI: 10.15728/bbr.2018.15.4.2

Douglas, J. W., & Franklin, A. L. (2006). Putting the brakes on the rush to spend down end-of-year balances: Carryover money in Oklahoma State Agencies. *Public Budgeting & Finance, 26*(3). 46-64. DOI: 10.1111/j.1540-5850.2006.00854.x

Durtschi, C., Hillison, W., & Pacini, C. (2004). The effective use of Benford's Law to assist in detecting fraud in accounting data. *Journal of Forensic Accounting, V*, 17–34.

Indriati, E. (2014). *Pola dan akar korupsi*. Jakarta: Gramedia Pustaka Utama.

Juwono, V., & Mayasari, I. (2019). Pola korupsi pemerintah daerah dan pimpinan transformasional. *Publik Bicara*. Retrieved from https://www.kpk.go.id/id/berita/publik-bicara/782-pola-korupsi-pemerintah-daerah-dan-pimpinan-transformasional.

KPK. (2018). *TPK berdasarkan jenis perkara*. Retrieved from https://acch.kpk.go.id/id/statistik/tindak-pidana-korupsi/tpk-berdasarkan-jenis-perkara.

Kuruppu, N. (2019). The Application of Benford's Law in fraud detection: A systematic methodology. *International Business Research, 12*(10), 1–10.

Lanham, S. W. (2019). Analyzing big data with Benford's Law: A lesson for the classroom. *American Journal of Business Education (AJBE)*, *12*(2), 33–42. DOI: 10.19030/ajbe.v12i2.10285

Mujiono. (2012). Pemanfaatan spreadsheet Microsoft Excel untuk pembelaran Benford's Law pada analisa data transaksi BBM bersubsidi. *Konferensi Nasional Pembelajaran Informatika*, 50–55.

Murhaban, M., & Jufrizal, J. (2017). Analisis penggunaan Benford's Law dalam perencanaan audit di Direktorat Jenderal Bea dan Cukai Cabang Kota Lhokseumawe. *Jurnal Akuntansi dan Keuangan, 5*(1), 39–50.

Musriaddin., Abdullah, M., & Asni, N. (2018). *Efektivitas pengguna Benford's Law* *dalam mendeteksi kecurangan laporan keuangan pada perusahaan yang terdaftar di Bursa Efek Indonesia*. (Skripsi). Universitas Halu Oleo Kendari, Indonesia.

Nigrini, M. J. (2012). *Benford's Law: Applications for forensic accounting, auditing, and fraud detection*. New Jersey: John Wiley & Sons, Inc.

Nugroho, H., Raharjo, A., & Pranoto. (2015). The optimization of corruption prevention towards Indonesia corruption-free. *Jurnal Dinamika Hukum*, *15*(3), 239-244.

Prabowo, H. Y. (2014). To be corrupt or not to be corrupt: Understanding the behavioral side of corruption in Indonesia. *Journal of Money Laundering Control,* 17(3), 306-326. DOI 10.1108/JMLC-11-2013-0045

Prasetyo, K. A., & Djufri, M. (2020). Penggunaan Benford'S Law untuk menentukan prioritas audit pajak pertambahan nilai. *Scientax Jurnal Kajian Ilmiah Perpajakan Indonesia, 1*(2), 167–183.

Restianto, Y. E., & Bawono, I. R. (2011). *Audit sistem informasi menggunakan active data for excel*. Yogyakarta: Penerbit Andi.

Setyawan, E. C. (2020). The use of Benford's Law in performance audit to detect fraud in the state expenditure transactions assisted by IDEA software (A case study at the Transportation Ministry Work Units). *Asia Pacific Fraud Journal*, *5*(1), 147–159. DOI: 10.21532/apfjournal.v5i1.145

Shein, M., & Lanza, R. (2009). *Fraud detection with active data for excel ebook*. Canada: Information Active Inc.

Shofy, M. A. (2016). Penggunaan Benford Law untuk pendeteksian fraud di Hotel ABC. *Jurnal Ilmiah Mahasiswa FEB Universitas Brawijaya*, *4*(2), 1-20.

Singleton, T. W., & Singleton, A. J. (2010). *Fraud auditing and forensic accounting*. Fourth Edition. New Jersey: John Wiley & Sons, Inc.

Tota, I., Aliaj, A., & Lamçja, J. (2016). The use of Benford's Law as a tool for detecting fraud in accounting data. *Interdisciplinary Journal of Research and Development*, 3(1), 73-77.

U.S. General Services Administration. (2012). *Procurement fraud handbook*. Retrieved from https://www.gsaig.gov/sites/default/files/misc-reports/ProcurementFraudHandbook_0.pdf

Wijaya, I. F. (2013, Januari 14). Minimnya daya serap anggaran. *Media Online Gagasan Hukum*. Retrieved from https://gagasanhukum.wordpress.com/tag/minimnya-daya-serap-anggaran.

APPENDICES

Appendix 1. First Two Digits Test (FTD) Results

First Two Digits Test	First Two Digits	Count	Proportion	Benford Proportion	Difference	Upper Bound	Lower Bound	Z Statistic
Analysis For: Amount	50	1050	0,037494644	0,008600172	0,028894472	0,0096996	0,007500744	52,32958757
	60	909	0,032459649	0,007178585	0,025281064	0,008185295	0,006171874	50,07402631
	30	1355	0,048385945	0,014240439	0,034145506	0,015646088	0,01283479	48,19901827
	90	643	0,022961006	0,004798883	0,018162123	0,005626213	0,003971552	43,93320693
	25	1312	0,04685045	0,017033339	0,029817111	0,018566837	0,015499841	38,53586461
	75	579	0,020675618	0,005752329	0,014923289	0,006656008	0,00484865	32,98028695
	80	504	0,017997429	0,005395032	0,012602397	0,006270913	0,004519151	28,74709989
	40	719	0,025674904	0,010723865	0,014951038	0,011948179	0,009499552	24,26034112
	70	473	0,016890444	0,006160309	0,010730136	0,007094674	0,005225943	22,90875349
	11	370	0,013212398	0,037788561	0,024576163	0,040039952	0,03553717	21,55072968
	10	1794	0,064062277	0,041392685	0,022669592	0,043743781	0,039041589	19,02822636
	20	1044	0,037280389	0,021189299	0,016091089	0,022894038	0,01948456	18,67560103
	13	370	0,013212398	0,032184683	0,018972285	0,034269814	0,030099553	17,97085883
	35	666	0,023782317	0,012234456	0,01154786	0,013539959	0,010928954	17,55048692
	45	532	0,018997286	0,009545318	0,009451968	0,010702085	0,00838855	16,23556836
	14	405	0,01446222	0,029963223	0,015501004	0,031978022	0,027948424	15,19672044
	21	262	0,009355806	0,020203386	0,01084758	0,021869243	0,018537529	12,88001298
	17	361	0,012891016	0,024823584	0,011932568	0,026663871	0,022983296	12,81411727
	23	230	0,008213112	0,018483406	0,010270293	0,020078935	0,016887876	12,73697414
	12	584	0,020854164	0,034762106	0,013907943	0,036925556	0,032598656	12,68860008
	95	267	0,009534352	0,004547628	0,004986724	0,005353582	0,003741673	12,35758826
	19	344	0,012283959	0,022276395	0,009992435	0,024022904	0,020529886	11,30949075
	16	437	0,015604914	0,026328939	0,010724025	0,028222222	0,024435656	11,18897392
	99	246	0,008784459	0,004364805	0,004419654	0,005154827	0,003574784	11,17317098
	31	179	0,006391944	0,013788284	0,00739634	0,015172036	0,012404533	10,58780466
	34	156	0,005570633	0,012589127	0,007018495	0,013912926	0,011265328	10,50678473
	41	125	0,004463648	0,010465434	0,006001786	0,011675277	0,009255591	9,839461042
	85	256	0,009141551	0,005079526	0,004062026	0,005930072	0,004228979	9,519244982
	29	222	0,007927439	0,014723257	0,006795818	0,01615189	0,013294624	9,416662494
	47	119	0,004249393	0,009143379	0,004893986	0,010276136	0,008010623	8,57226236
	43	139	0,004963577	0,009984221	0,005020644	0,01116662	0,008801822	8,420015496
	96	220	0,007856021	0,004500501	0,003355519	0,00530238	0,003698622	8,343925749
	46	128	0,004570776	0,009340026	0,004769251	0,010484597	0,008195456	8,265395872

First Two Digits Test	First Two Digits	Count	Proportion	Benford Proportion	Difference	Upper Bound	Lower Bound	Z Statistic
	44	146	0,005213541	0,009759837	0,004546296	0,010929207	0,008590468	7,707898765
	38	182	0,006499072	0,01128101	0,004781939	0,012535918	0,010026103	7,548276131
	18	468	0,016711898	0,023481096	0,006769198	0,025272638	0,021689553	7,460527119
	18	468	0,016711898	0,023481096	0,006769198	0,025272638	0,021689553	7,460527119
	61	93	0,003320954	0,007061854	0,0037409	0,00806055	0,006063159	7,439720342
	15	989	0,035316383	0,028028724	0,00728766	0,029979908	0,026077539	7,370097955
	28	278	0,009927153	0,015239967	0,005312813	0,016692765	0,013787168	7,232428841
	26	305	0,010891301	0,016390416	0,005499115	0,017895521	0,014885311	7,223586507
	74	72	0,002571061	0,005829544	0,003258482	0,006739113	0,004919974	7,122953674
	55	319	0,01139123	0,007825338	0,003565892	0,008875297	0,006775378	6,737849819
	98	197	0,007034709	0,004409119	0,00262559	0,005203033	0,003615205	6,586062148
	39	194	0,006927582	0,010995384	0,004067803	0,012234708	0,009756061	6,498660008
	62	285	0,010177118	0,00694886	0,003228258	0,007939732	0,005957988	6,466892436
	67	108	0,003856592	0,00643411	0,002577518	0,007388493	0,005479727	5,356965883
	58	137	0,004892158	0,007424018	0,00253186	0,008447367	0,006400669	4,900533466
Analysis For: Amount	24	393	0,014033709	0,017728767	0,003695057	0,019292348	0,016165186	4,6627414
	79	95	0,003392373	0,005462896	0,002070523	0,006344127	0,004581664	4,659886763
	77	101	0,003606628	0,005603878	0,00199725	0,006496116	0,004711639	4,436974806
	64	129	0,004606485	0,006733383	0,002126898	0,007709154	0,005757611	4,315333994
	65	243	0,008677332	0,006630579	0,002046753	0,007599059	0,005662099	4,183190426
	57	151	0,005392087	0,007553138	0,002161051	0,008585127	0,006521149	4,142124446
	86	92	0,003285245	0,005020801	0,001735556	0,005866545	0,004175058	4,066610943
	89	89	0,003178117	0,004852503	0,001674385	0,005684321	0,004020684	3,988882421
	36	261	0,009320097	0,011899223	0,002579126	0,013187178	0,010611269	3,952521909
	76	109	0,003892301	0,005677133	0,001784832	0,006575036	0,00477923	3,935329404
	81	101	0,003606628	0,005328834	0,001722206	0,006199463	0,004458204	3,917253154
	69	123	0,00439223	0,006248949	0,00185672	0,007189844	0,005308055	3,904684609
	42	220	0,007856021	0,010219165	0,002363145	0,011415047	0,009023284	3,902095277
	54	172	0,00614198	0,00796893	0,00182695	0,00902824	0,006909619	3,404687289
	93	91	0,003249536	0,004644905	0,001395369	0,005459205	0,003830605	3,389978962
	78	116	0,004142265	0,005532489	0,001390223	0,006419171	0,004645806	3,095946328
	66	143	0,005106413	0,006530867	0,001424454	0,007492219	0,005569515	2,922038806
	63	152	0,005427796	0,006839425	0,001411629	0,007822658	0,005856191	2,829769327

First Two Digits Test	First Two Digits	Count	Proportion	Benford Proportion	Difference	Upper Bound	Lower Bound	Z Statistic
Analysis For: Amount	82	113	0,004035138	0,00526424	0,001229102	0,006129712	0,004398768	2,800846524
	56	174	0,006213398	0,007686829	0,001473431	0,008727684	0,006645973	2,788785802
	48	210	0,007498929	0,008954843	0,001455914	0,01007615	0,007833535	2,554343797
	94	101	0,003606628	0,004595752	0,000989124	0,005405846	0,003785658	2,402921544
	72	197	0,007034709	0,005990364	0,001044346	0,006912076	0,005068651	2,225928497
	52	261	0,009320097	0,008272526	0,001047571	0,009351327	0,007193725	1,902306097
	88	115	0,004106556	0,004907334	0,000800778	0,005743716	0,004070953	1,874746041
	59	179	0,006391944	0,007299239	0,000907295	0,008314164	0,006284313	1,748423094
	37	351	0,012533924	0,011581873	0,000952051	0,012852977	0,010310768	1,461020679
	91	123	0,00439223	0,004746435	0,000354205	0,005569351	0,003923519	0,818874755
	87	147	0,00524925	0,00496342	0,000285831	0,005804442	0,004122397	0,638058853
	92	125	0,004463648	0,004695121	0,000231473	0,005513694	0,003876548	0,522891226
	84	146	0,005213541	0,00513964	7,39013E-05	0,005995073	0,004284206	0,131148017
	Total	**28000**		**Mean Absolute Difference**	**0,006455742**			

Number Frequency Factor	**NFF**	**Duplications**
	0,0090	**1.517**
Relative Size Factor	**RSF**	
	1,0001	

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Appendix 2. Summary of F2D, Z-Statistic, MAD, DT, NFF, RSF Test Results Based on Types of Cash Disbursement

		MAD*			Conformity**		Nonconformity						
No	Types of Cash Disbursement	N Obser-vation	Value	Conclusion	N Obser-vation	%	N Obser-vation	%	Extreme Digits	NFF***	RSF	Duplications	
1	Procurement of goods/services	6.610	0,0051	Nonconformity	1660	25,1%	4.950	74,9%	99, 98, 70, 75, 30, 80, 60, 50, 90	0,0046	1,0005	658	10,0%
2	Purchase of food and beverage	8.028	0,0044	Nonconformity	2350	29,3%	5.678	70,7%	20, 45, 75, 50, 30, 90, 60	0,0066	1,0001	669	8,3%
3	Miscellaneous payments	8.174	0,0065	Nonconformity	979	12,0%	7.195	88,0%	13, 25, 11, 70, 10, 40, 30, 80, 90, 60, 75, 50	0,0073	1,0004	705	8,6%
4	Subscription to power & services	292	0,0103	Nonconformity	135	46,2%	157	53,8%	50, 52, 22, 30, 90	0,0168	1,0055	36	12,3%
5	Honorarium of non-permanent employee	350	0,0132	Nonconformity	100	28,6%	250	71,4%	30, 70, 40, 60, 80	0,0390	1,0417	34	9,7%
6	Business trip by office vehicles	1.581	0,0123	Nonconformity	328	20,7%	1.253	79,3%	65, 40, 50, 70, 30, 60, 25, 35	0,0488	1,0025	83	5,2%
7	Purchase of vehicle fuel	355	0,0125	Nonconformity	96	27,0%	259	73,0%	60, 95, 50, 30, 20	0,0574	1,0556	32	9,0%
8	Contribution to other organization	279	0,0161	Nonconformity	25	9,0%	254	91,0%	75, 10, 60, 80, 30	0,0702	1,0526	19	6,8%
9	Field operational cost	348	0,0156	Nonconformity	63	18,1%	285	81,9%	80, 60, 50, 37, 62	0,0893	1,0309	22	6,3%
10	Contribution to social activities	841	0,0151	Nonconformity	106	12,6%	735	87,4%	20, 30, 95, 50, 10	0,1120	1,0010	30	3,6%
11	Business trip by public transportation	1.142	0,0140	Nonconformity	218	19,1%	924	80,9%	40, 35, 60, 30, 25	0,1458	1,0020	52	4,6%
12	Incentives	4	0,0211	Nonconformity	1	25,0%	3	75,0%	38, 40, 65	0,0000	1,6250	0	0,0%
	Total	28.004			6.061	21,6%	21.943	78,4%				2.340	

*) Nonconformity: MAD > 0,0022
**) Conformity: Z-statistic < 1,96
***) NFF: good if the value is close to

Appendix 3. Summary of F2D, Z-Statistic, MAD, DT, NFF, RSF Analysis Results Based on Timing of Cash Disbursement

			MAD*		Conformity**		Nonconformity						
No	Month of	N Obser-vation	Value	Conclusion	N Obser-vation	%	N Obser-vation	%	Extreme Digits	NFF***	RSF	Duplications	
1	October	2.831	0,0081	Nonconformity	611	21,6%	2.220	78,4%	10, 90, 35, 30, 50, 60, 25	0,0194	1,0020	265	9,4%
2	November	4.112	0,0077	Nonconformity	606	14,7%	3.506	85,3%	10, 40, 60, 90, 75, 25, 35, 30, 50	0,0141	1,0004	357	8,7%
3	April	2.502	0,0073	Nonconformity	768	30,7%	1.734	69,3%	50, 40, 60, 90, 25, 30	0,0136	1,0019	273	10,9%
4	December	5.043	0,0065	Nonconformity	1266	25,1%	3.777	74,9%	70, 80, 95, 30, 90, 75, 60, 50	0,0089	1,0001	438	8,7%
5	August	2.214	0,0065	Nonconformity	604	27,3%	1.610	72,7%	90, 20, 60, 30, 50	0,0086	1,0010	252	11,4%
6	July	2.277	0,0064	Nonconformity	753	33,1%	1.524	66,9%	80, 62, 90, 60, 50	0,0083	1,0004	263	11,6%
7	September	1.648	0,0062	Nonconformity	669	40,6%	979	59,4%	30, 75, 10, 50, 60	0,0098	1,0025	200	12,1%
8	June	1.299	0,0062	Nonconformity	616	47,4%	683	52,6%	50, 75, 90, 30, 60	0,0082	1,0010	180	13,9%
9	May	2.295	0,0059	Nonconformity	803	35,0%	1.492	65,0%	80, 90, 30, 50, 60	0,0073	1,0025	254	11,1%
10	February	1.378	0,0055	Nonconformity	751	54,5%	627	45,5%	50, 80, 30, 60,90	0,0066	1,0025	172	12,5%
11	March	2.396	0,0054	Nonconformity	1075	44,9%	1.321	55,1%	50, 80, 60, 90, 30	0,0059	1,0012	303	12,6%
12	January	9	0,0195	Nonconformity	8	88,9%	1	11,1%	22	0,0494	1,5833	1	11,1%
	Total	28.004			8.530	30,5%	19.474	69,5%				2.958	

*) Nonconformity: MAD > 0,0022
**) Conformity: Z-statistic < 1,96
***) NFF: good if the value is close to

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