CHAPTER FOUR
Research Methodology

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4.2 • The research methodology framework

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4.1 Introduction
This chapter is designed for the exploration of ideas from which research has been originated. This chapter reveals the theoretical underpinning of whole research process. The research method in this chapter is designed to explore forensic accounting education and practice for fraud prevention and detection in India’s public service. It is aimed at:

- Quantifies the level of effectiveness of forensic accounting techniques and their perceived use.
- Exploring the factors that hinder the application of forensic accounting techniques in fraud prevention and detection in India.
- To know the practitioners intention to use forensic accounting techniques as major fraud prevention and detection mechanism.
- Quantifies the level of awareness of forensic accounting education among practitioners as well as academics and
- To find out the readiness of Indian Universities in taking up forensic accounting courses as an integral part of their syllabi.

The chapter considers the main philosophical positions that underlie the designs of this study. It seeks to describe the philosophical basis that drives the methodology directed towards achieving the aim and objectives of the research.

4.2 The research methodology framework
Research methodology framework is whole warp weft of the research by which researcher starts his research and fulfill the requirements of objective of research.
Very first step of research methodology framework is problem genesis. Problem genesis of this research is developed by the last few years of giant scams and financial scandals. These scams coerced to accounting practitioners to re-think about the effectiveness of traditional accounting and auditing system.
The research method in this chapter is designed to explore forensic accounting education and practices for fraud prevention and detection in India’s public sector. It is aimed at:

- investigating the mechanisms of fraud prevention and detection, and their levels of effectiveness in India;
- identifying the major factors that hinder the application of forensic accounting techniques in fraud prevention and detection in India;
- examining practitioners’ opinions and behavioral intention to use forensic accounting techniques in fraud prevention and detection in India;
- Exploring the levels of awareness of forensic accounting techniques among practitioners, students and academics in India.

The chapter focuses the main hypothetical positions that establish the designs of this study. It requires describing the hypothetical basis that drives the methodology directed towards achieving the aim and objectives of the research.

Many arguments, criticism and debates are important in the progress of philosophy and therefore it is important to understand both sides of an argument because research problems require eclectic design, which draws from more than one tradition (Adelopo, 2010). In answering the main questions of this study, the research methodology framework, as depicted in the ‘Research Onion’ (Figure 4.1) is used.
Figure 4.1: The Research Onion

Source: Saunders, Lewis and Thornhill (2009, p 138)

Above research onion is clearly explaining the concept of research methodology. As figure 4.1 depicts that first layer in every research is philosophy execution. Philosophy is the basic idea of any research that should have been developed at early stage of research. After the philosophy execution, researcher has to decide the main research approach whether it is deductive or inductive. After the determination of research approach, researcher has to decide his type of research, whether research will classified in case study, experiment or survey.

Subsequent stage of type of research is method of research. After that researcher should decide the scope of the study, if it is comparative study then it should be classified in to cross sectional otherwise longitudinal.
Last stage in research is data collection and analysis from which production of result is started.

Main research methodology frame work may be defined as the process start from the research question and ends with the application of research technique and process. Research methodology frame work of this research can be better explained by following figure:

As above figure explains that very first step is setting up of research objectives. A research objective is a clear, concise, declarative statement, which provides direction to investigate the variables. Generally research objective focus on the ways to measure the variables, such as to identify or describe them. Sometime objectives are directed towards identifying the relationship or difference between two variables. Research objective are the results sought by the researcher at the end of the research process, i.e. what the researcher will be able to achieve at the end of the research study. The objectives of a research project summarize what is to be achieved by the study. Objective should be closely related to the statement of the problem.

Research question is the methodological point of departure of scholarly research in both the natural and social sciences. The research will answer the question posed. The research question must be accurately and clearly defined. Choosing a research question is the central element of both quantitative and qualitative research and in some cases it may precede construction of the conceptual framework of study. In all cases, it makes
the theoretical assumptions in the framework more explicit, most of all it indicates what the researcher wants to know most and first. The research question serves two purposes:

- It determines where and what kind of research the writer will be looking for and
- It identifies the specific objectives the study or paper will address.

The hypothesis is directly related to a theory but contains operationally defined variables and is in testable form. Hypotheses allow us to determine, through research, if our theory is correct. In other words, does prior work experience result in better grades? (Dr. Christopher L. Heffner, 2013). Characteristics of a good hypothesis are:

1. It is written in the form of a concise statement.
2. It reflects a position being taken by the writer.
3. It is arguable, and a contrary position can be taken.
4. It requires research to determine whether or not it is true.
5. It is a significant matter to social scientists.
6. It is a complex notion, dealing with a number of variables.
7. It is not written in the first person.
8. It can be tested.

(Transitions in Society, Pg. 65-66)

Research methods are tools by which a researcher fulfills the object of his research. Research methods are based on hypothesis of the study.

### 4.3 Data Source

There are mainly two type of data source on the basis of collection sources thereof; primary and secondary. Our research is exploratory
research which explored the various elements and components of forensic accounting and fraud auditing in Indian context. In this research, primary data is mainly used for the data source. However secondary data has also been used to present the fraud prevalence in Indian economy. This section is described in the chapter 6 “Data Collection and Analysis.”

4.4 Data collection Instruments

Structured questionnaires have been used in the study for the data collection. A new technique of questionnaire named as “Google Forms” used by researcher for data collection. It is an online mailed form of questionnaire which is often used in survey research. This section is also described in chapter 6

4.5 Scales of Measurements

Mainly there are four types of measurement of scales. The nominal scale of measurement only satisfies the identity property of measurement. Values assigned to variables represent a descriptive category, but have no inherent numerical value with respect to magnitude.

The ordinal scale has the property of both identity and magnitude. Each value on the ordinal scale has a unique meaning, and it has an ordered relationship to every other value on the scale.

The interval scale of measurement has the properties of identity, magnitude, and equal intervals.

The ratio scale of measurement satisfies all four of the properties of measurement: identity, magnitude, equal intervals, and a minimum value of zero.
Ratio as well as nominal scale have used in this study. Most of the responses are recorded in five levels Likert scales. Only nominal questions like “Are you aware from forensic accounting?” have been recorded in nominal scales, rest of the questions have been recorded in ratio scale.

4.6 Hypotheses

Keeping into consideration the objectives and research question of the study, the following null and alternate hypotheses were framed and tested:

$H_{01}$: There is no significant difference between the actual use of fraud prevention and detection mechanisms, and their perceived level of effectiveness.

$H_1$: There is significant difference between the actual use of fraud prevention and detection mechanisms, and their perceived level of effectiveness.

$H_{02}$: Educational activities of Indian universities will not positively influence awareness in forensic accounting techniques.

$H_2$: Educational activities of Indian universities will positively influence awareness in forensic accounting techniques.

$H_{03}$: Awareness of forensic accounting techniques will not positively influence the perceived benefits of using it in fraud prevention and investigation in India.

$H_3$: Awareness of forensic accounting techniques will positively influence the perceived benefits of using it in fraud prevention and investigation in India.
H₀₄: Awareness of forensic accounting techniques will not negatively influence the perceived risks of using it in fraud prevention and investigation in India.

H₄: Awareness of forensic accounting techniques will negatively influence the perceived risks of using it in fraud prevention and investigation in India.

H₀₅: The perceived benefits of using forensic accounting techniques will not positively influence the intention to use it as major fraud prevention and investigation method in India.

H₅: The perceived benefits of using forensic accounting techniques will positively influence the intention to use it as major fraud prevention and investigation method in India.

H₀₆: The perceived risks of using forensic accounting techniques will not negatively influence the intention to use it as major fraud prevention and investigation method in India.

H₆: The perceived risks of using forensic accounting techniques will negatively influence the intention to use it as major fraud prevention and investigation method in India.

H₀₇: The perceived severity of fraud will not positively influence practitioners’ intention to use forensic accounting techniques in fraud prevention and investigation in India.
H7: The perceived severity of fraud will positively influence practitioners’ intention to use forensic accounting techniques in fraud prevention and investigation in India.

H08: There is no significant variation in the level of awareness of forensic accounting techniques amongst accounting practitioners and academics.

H8: There is a significant variation in the level of awareness of forensic accounting techniques amongst accounting practitioners and academics.

H09: Indian universities are not ready to take up forensic accounting courses.

H9: Indian universities are ready to take up forensic accounting courses.

4.7 Data Analysis

Data analysis has been made through various test and measurement which have proved best fit for particular hypothesis. Following table showing the data analysis test for particular hypothesis:
<table>
<thead>
<tr>
<th>Objective</th>
<th>Research Questions</th>
<th>Hypotheses</th>
<th>Research Methods</th>
<th>Application</th>
</tr>
</thead>
</table>
| 1. To investigate the mechanisms of fraud prevention and detection, and their levels of effectiveness in India. | 1. What are the common fraud prevention and detection mechanisms?  
1.1. What is the perceived level of effectiveness of fraud prevention and detection methods in India?  
1.2. Is there any significant difference between the use of common fraud prevention and detection mechanisms and their perceived level of effectiveness? | There is a significant difference between the mechanisms of fraud prevention and detection in actual usage and their perceived levels of effectiveness | Students’ t-test                        | Used to compare the difference in the means between the actual usage of mechanisms of forensic accounting techniques and their perceived level of effectiveness in fraud prevention and detection in India |
| 2. To identify the major factors that hinder the application of forensic accounting techniques in fraud prevention and detection in India | 2. What are the major factors that hinder the application of forensic accounting in fraud prevention and detection in India? | Factor analysis                                                                                  | Used to extract the major factors that hinders the application of FA in India                  |                                                                                               |
| 3. To examine practitioners’ opinions and behavioral intention to use forensic accounting techniques in fraud prevention and detection in India | 3. What are the practitioners’ opinions and behavioral intention to use forensic accounting techniques in fraud prevention and detection in India?  
3.1. How would educational activities influence awareness in forensic accounting?  
3.2 Is there any positive influence of awareness of forensic accounting on its perceived benefits for fraud prevention and detection?  
3.3 Is there any negative | 2 Educational activities of Indian universities will positively influence awareness in forensic accounting techniques  
3. Awareness of forensic accounting techniques will positively influence the | Bivariate correlation analysis of Karl Pearson’s |                                                                                               |
influence of awareness of forensic accounting on its perceived benefits for fraud prevention and detection?

3.4 How would perceived benefits of using forensic accounting positively influence its use for fraud prevention and detection?

3.5 How would perceived risks of using forensic accounting negatively influence its use for fraud prevention and detection?

3.6 How would perceived susceptibility to fraud positively influence practitioners’ intention to use forensic accounting techniques in fraud prevention and detection in India?

3.7 How would perceived severity of fraud positively influence practitioners’ intention to use forensic accounting techniques in fraud prevention and detection in India?

perceived benefits of using it in fraud prevention and detection in India

4. Awareness of forensic accounting techniques will negatively influence the perceived risks of using it in fraud prevention and investigation in India

5. The perceived benefits of using forensic accounting techniques will positively influence the intention to use it as major fraud prevention and investigation method in India

6. The perceived risks of using forensic accounting techniques will negatively influence the intention to use it as major fraud prevention and detection
4. To explore the level of awareness of forensic accounting techniques in India

4. What is the level of awareness of forensic accounting techniques among the undergraduate in India?

9. There is a significant variation in the level of awareness of forensic accounting techniques among practitioners, students and academics in India.

<table>
<thead>
<tr>
<th>Method in India</th>
</tr>
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<tbody>
<tr>
<td>7. The perceived susceptibility to fraud will positively influence practitioners’ intention to use forensic accounting techniques in fraud prevention and detection in India.</td>
</tr>
<tr>
<td>8. The perceived severity of fraud will positively influence practitioners’ intention to use forensic accounting techniques in fraud prevention and detection in India.</td>
</tr>
</tbody>
</table>

Two sample Z test

Test to explore the level of awareness of forensic accounting techniques among practitioners and academics. The Z was used to examine if significant difference exist.
4.9 Research approaches: quantitative vs. qualitative

There are two main approaches in conducting a research. These are the deductive and inductive approaches. Researches that follow the positivist strand are generally classified as deductive. Such researches, which are ideal scientific investigations, follow a series of logical, orderly steps to formulate and test hypotheses (Adelope, 2010). This series of logical steps is known as deductive reasoning. This might be thought of as “top-down” reasoning – proceeding from the general knowledge to the specific knowledge. Starting with a general principle, a testable prediction is derived about a specific case. On the other hand, the inductive approach (“bottom-up reasoning), which supports the interpretivism philosophy, studies specific examples and try to discover patterns and derived general explanations from collected observations (Saunders, Lewis and Thornhill, 2009). These two approaches are adopted in this study, as the researcher intends to use the strength of one to complement the weakness of the other with the aim of providing acceptable explanation to the phenomenon under study, which is the application of forensic accounting in fraud prevention and detection in India. Crowther and Lancaster
(2009) opined that to achieve effectiveness in management research may require the combination of inductive and deductive methods. However, the deductive methods are given higher preference.

**Techniques and Methods of forensic accounting**

**High level Data Overview tests**

This test totally based on data mining. In this test, investigator does perforation of the data. This is a type of retrenchment of data in which the data, significantly material are retrenched. As stated from the name in this test data is overviewed by the investigator. By the help of this technique, data is divided in various strata from the point of view of mathematical and quantum of transactions. MS Excel and MS Access are fully used in this type of data mining.

After the making of strata of data, analyze will be made on the basis of result produced according to above test. There are mainly three sub tests involved in “High Level Data Overview Tests”. In other words it can be said that there are three ingredients in High Level Data Overview Test which are as follows:-

1. Data Profile
2. Data Histogram and
3. Periodic graph

**Data Profile**

This is the first test to be run on the data because this test might find serious issues that show that it is not a good idea to continue with the analysis. This test indicates that data, with which we are working, is adequate or not. As described in the first section of this chapter that in
this test, strata of the data will be made on the basis of their amount. Usually following strata are made in this test:-

- Amounts equals to or larger than 10000.
- Amounts from 5000 to 9999.
- Amounts from 1001 to 4999.
- Amounts from 101 to 1000.
- Amounts equal to or smaller than 100.

Extra strata can be made according to requirement of investigator. If investigator wants to focus on a specific group of transactions, for example accounts payable then extent or limit may be set according to convenient of investigator. These extra strata could point internal auditors to the low-value items (that cost money to process) and to the high-value items that would usually be material. It is usually more efficient in a statistical sampling context to sample from the high-value strata at a higher rate than from the low-value strata.

In MS excel, a work book named as “Data Profile” will be made. On the basis of above stated strata, first of all counting of strata, which are between the limit of strata, will be made. Counting can be made as per “Countif” function. For above first strata “Countif” function will be as follows:-

=COUNTIF(Data1!D2:D15947, “>=10000”)

In above function, “Data 1” is the name of data sheet and D2:D15947 is range between which amount will be counted whereas “>=10000” is criteria.

Likewise second strata will be counted as follows:-

=COUNTIF(Data1!D2:D15947, “>=5000, Data1!D2:D15947, “<=9999”)
Third strata will be counted as follows:-

=countif(Data 1!D2:D15947, “>=1001, Data 1!D2:D15947, “<=4999”)

Fourth strata will be counted as follows:-

=countif(Data 1!D2:D15947, “>=101, Data 1!D2:D15947, “<=1000”)

Fifth strata will be counted as follows:-

=countif(Data 1!D2:D15947, “<=100)

In above functions, we assumed that there are 15947 cells in D column.

This test may also be regulated in MS Access. MS Access is more efficient tool than MS Excel. If data sets are prepared in MS excel format then Excel sheet can be imported in MS Access (Import using External Data → Import → Excel). The Excel file was imported using the First row contains column headings option. The Date field was formatted as Date/Time and the Amount field was formatted as Currency. The Let Access Add Primary Key option was accepted.

Possible benefits of the data profile

As stated from the name of test data profile provides the profile of data set to be investigated. It provides a understanding about out data set. Some of the results listed below:

1. Completeness of data: - This test helps to auditor or investigator to know whether data set to be investigated whether complete or not. This may be possible by the reconciliation of the total amount and total of amount column of strata column. In an external audit one of the management assertions is the assertion of completeness. Generally investigator assumers that the data set with which he is working is complete in quantum. In a forensic investigation there is
no such assertion, so forensic investigator does needs to know that the data being analyzed is complete or not.

2. **Proportion of low value invoices**: Generally it finds that making of fake low value invoices are easier in compare of high value fake invoices. Hence fraud preparatory focuses on fake low value invoices in large quantity. By the above stated strata investigator is able to know the proportion of such low value invoices to total invoices. However there is no rule of thumb to decide that what the normal proportion is. But such type of proportion provides a direction to investigation to investigator by the help of which investigator may precede of his forth work.

**Data Histogram**

Data histogram is the graphical presentation of result extracted from data profile. It makes easier to result interpretation of data profile. The histogram itself is a graph made up of vertical bars constructed on a horizontal line (the x-axis) that is marked off with intervals. These intervals should include all the amounts in the data set and should not overlap. The height of each bar in the histogram indicates the number of records in the interval.
At last it can be said that data histogram enables to investigator to understating the data in first view.

**Periodic graph**

The periodic graph is the last of the three high-level tests related to the distribution of the data. This test divides the data into time periods and shows the total per time period on a graph with time shown on the x-axis. This is useful for a better understanding of the data, and also to detect large anomalies.

The periodic graph shows relatively high totals for particular months of record.

Source: MARK J. NIGRINI (2011), p 68
Reconciliation Statements

A reconciliation statement is a document that begins with a company's own record of an account balance, adds and subtracts reconciling items in a set of additional columns, and then uses these adjustments to arrive at the record of the same account held by a third party. The intent of the reconciliation statement is to provide an independent verification of the veracity of the balance in the company account, as well as to clarify the differences between the two versions of the account.

The differences between the two accounts are detailed in the reconciliation statement, which makes it easier to determine which of the reconciling items may be invalid and in need of adjustment. Reconciliation statements are an extremely useful tool for both internal and external auditors. External auditors will likely want to use internally-prepared reconciliation statements as part of their auditing procedures, since the statements allow them to focus on reconciling items, especially in large-balance accounts that are materially significant components of the financial statements.

Reconciliation statements are commonly constructed in the following situations:

Bank accounts: - The bank reconciliation compares the balances between a company's version of its cash balance and the bank's version, typically with many reconciling items for such items as deposits in transit and uncashed checks. This reconciliation is typically provided as a module within a company's accounting software.

Debt accounts: - The debt reconciliation compares the debt amounts outstanding according to the company and its lender. There can be
differences requiring reconciliation when the company pays the lender, and the lender has not yet recorded the payment in its books.

Accounts receivable: The receivables reconciliation is usually constructed on an informal basis for individual customers, and compares their version of outstanding receivable balances to the company's version.

Accounts payable: The payables reconciliation is also usually constructed on an informal basis by individual supplier, and compares their version of outstanding payable balances to the company's version.

At a minimum, reconciliation statements are useful for noting timing differences in when the same transaction is recorded by both parties to a transaction. The statements are even more useful for clarifying substantial differences between the amounts recorded for a transaction, which may require adjustments by either party to modify their recorded balances.

**Corporate Governance**

Corporate governance broadly refers to the mechanisms, processes and relations by which corporations are controlled and directed. Governance structures identify the distribution of rights and responsibilities among different participants in the corporation (such as the board of directors, managers, shareholders, creditors, auditors, regulators, and other stakeholders) and include the rules and procedures for making decisions in corporate affairs. Corporate governance includes the processes through which corporations' objectives are set and pursued in the context of the social, regulatory and market environment. Governance mechanisms include monitoring the actions, policies and decisions of corporations and their agents. Corporate governance practices are affected by attempts to align the interests of stakeholders.
Initially, forensic accountants were used by government agencies (such as, the CIA, the FBI, and the IRS), to uncover and investigate leading frauds. They became financial detectives; independent experts employed by management to uncover fraudulent financial reporting and misappropriated assets. In the current reporting environment, forensic accountants are in great demand for their accounting, auditing, legal, and investigative skills. They can play a vital role in coordinating company efforts to achieve a cohesive policy of ethical behavior within an organization.

The definition of forensic accounting is changing in response to the growing needs of corporations. Bologna and Lindquist had defined Forensic accounting as “the application of financial skills, and an investigative mentality to unresolved issues, conducted within the context of rules of evidence. As an emerging discipline, it encompasses financial expertise, fraud knowledge, and a sound knowledge and understanding of business reality and the working of the legal system.” According to the definition developed by the AICPA’s Forensic and Litigation Services Committee, “forensic accounting may involve the application of special skills in accounting, auditing, finance, quantitative methods, the law, and research. It also requires investigative skills to collect, analyze, and evaluate financial evidence, as well as the ability to interpret and communicate findings. Forensic accounting encompasses litigation support, investigation, and dispute resolution and, therefore, is the intersection between accounting, investigation and the law.”

The interests of investors and other stakeholders are usually protected by a three-tier security system. At the top-level is the company’s “corporate
governance code,” which is directed toward enforcing company policies, achieving company objectives, monitoring company performance, and ensuring adequate disclosure of the company’s activities. At the other end are the “reporting system,” which is regulated by various public and private institutions, such as, the Securities and Exchange Commission (SEC), the Public Company Accounting Oversight Board (PCAOB), and Financial Accounting Standards Board (FASB), Securities and Exchange Board of India (SEBI), etc. These regulatory agencies require public companies to follow various accounting and disclosure standards, such as, Generally Accepted Accounting Principles (GAAP), and their auditors to audit as per Statement on Auditing Standards (SAS) like independence, ethical, and quality control standards. Linking the two extremes, however, is a company’s “system of internal controls,” which provides reasonable ‘assurance’ on the effectiveness and efficiency of operations, the ‘reliability’ of financial reporting, and ‘compliance’ with applicable laws and regulations. This system, however, seems to have been inadequate in many companies. As corporations scramble to realign their interests with those of their stakeholders, three main areas of weaknesses are emerging. (Madan Lal Bhasin, International Journal of Accounting Research Vol. 1, No.1, 2013)

**Operational Audit**

Operational Audit is a systematic review of effectiveness, efficiency and economy of operation. Operational audit is a future-oriented, systematic, and independent evaluation of organizational activities. In Operational audit financial data may be used, but the primary sources of evidence are the operational policies and achievements related to organizational objectives. Operational audit is a more comprehensive form of an internal audit. (https://en.wikipedia.org/wiki/Operational_auditing)
In other words a review of how an organization's management and its operating procedures are functioning with respect to their effectiveness and efficiency in meeting stated objectives. For example, a business might perform an operational audit if its senior management has become convinced that operational improvements can be made and need to be identified.

Now in recovery after a major global economic crisis, companies are reshaping their strategies to achieve sustainable business growth in new ways, and continuing to seek value creation through improved operational performance – including dimensions of quality, speed, agility, efficiency, environment, customer value, and cost.

Management is therefore focusing on initiatives and issues that impact upon the operating models of business activities and processes, such as environmental stewardship, operational excellence, supply chain optimization, offshoring, talent mobility, innovation, and cloud computing to name a few. Given these dynamics, internal audit is in a unique position to influence value enhancement efforts. This is achievable through Operational Auditing.

**Accounting Ratios**

Accounting ratios are a way of expressing the relationship between one accounting result and another, which is intended to provide a useful comparison. Accounting ratios assist in measuring the efficiency and profitability of a company based on its financial reports. Accounting ratios form the basis of fundamental analysis. An accounting ratio compares two aspects of a financial statement, such as the relationship (or ratio) of current assets to current liabilities. The ratios can be used to
evaluate the financial condition of a company, including the company's strengths and weaknesses.

Another useful fraud detection technique is the calculation of data analysis ratios for key numeric fields. Like financial ratios that give indications of the financial health of a company, data analysis ratios report on the fraud health by identifying possible symptoms of fraud. Three commonly employed ratios are:

1. The ratio of the highest value to the lowest value (max/min);
2. The ratio of the highest value to the second highest value (max/max2); and
3. The ratio of the current year to the previous year

Using ratio analysis, a financial expert studies relationships between specified costs and some measure of production, such as units sold, dollars of sales or direct labor hours. For example, to arrive at overhead costs per direct labor hour – Total overhead costs might be divided by total direct labor hours. Ratio analysis may help a forensic accountant to estimate expenses.

**Benford’s Law**

Benford’s Law provides a powerful tool with which to determine how “natural” a given set of financial data is likely to be. The tests are both straightforward and easily implemented on spreadsheets without the need of add-in or supplemental software. But, it is also important to remember that not all financial data lend themselves to such tests and that care must be exercised when performing the analysis.
The Law of Anomalous Numbers paper (Benford, 1938) begins with a note that in a book of logarithm tables, the pages show more stains and wear on those giving the logarithms of numbers with low first digits (1 and 2) than on those giving the logarithms of numbers with high first digits (8 and 9). Benford then speculated that this was because more of the numbers used (or “in existence”) had low first digits. The first stage of Benford’s research was to analyze the first digits of the numbers in 20 data tables. The first digit is the leftmost digit in a number, and, for example, the first digit of 110,364 is a 1. Zero is inadmissible as a first digit, which means that there are nine possible first digits (1, 2, . . . , 9).

The signs of negative numbers are ignored, so the first-two digits of –50.5 are 50. Benford’s tables had a total of 20,229 records. He collected data from as many sources as possible to include a variety of different types of data sets. His data varied from random numbers that had no relationship to each other, such as the numbers from the front pages of newspapers and all the numbers in an issue of Reader’s Digest, to mathematical tabulations, such as mathematical tables and scientific constants. Benford analyzed either the entire population or, in the case of large data sets, he worked to the point where he felt that he had a fair average. His work and calculations were done by hand and the work was probably quite time consuming.

Benford’s results showed that 30.6 percent of the numbers had a first digit 1. The first digit 2 occurred 18.5 percent of the time. This means that 49.1 percent of the numbers had a first digit that was either a 1 or a 2. In contrast, only 4.7 percent of the numbers had a first digit 9. Benford then saw that the actual proportion for the 1 was close to the logarithm of 2 (or 2/1), and the actual proportion for the 2 was close to the logarithm
of 3/2. This logarithmic pattern continued up to the 9 with the proportion for the digit 9 being close to the logarithm of 10/9.

It is a mathematical test which studies the data pattern and finds any discrepancy, if any, in data set. Benford has propounded many mathematical tests like first digit law, number duplication test etc. The benford’s law–based tests signal abnormal duplications. The mathematics of Benford’s Law gives us the expected or the normal duplications, and duplications above the norm are abnormal or excessive. Bolton and Hand (2002) state that the statistical tools for fraud detection all have a common theme in that observed values are usually compared to a set of expected values. They also say that depending on the context, these expected values can be derived in various ways and could vary on a continuum from single numerical or graphical summaries all the way to complex multivariate behavior profiles.

Below figures reveals the result of Benford’s first digit test. The first digit test compares the actual first digit frequency distribution of a data set with that developed by Benford. It is an extremely high-level test and will only identify obvious anomalies (i.e., it will only point you in the right direction). It should not be used to select targets for sampling, as the sample size will be too large.
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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**Chi-Square Probability**: 7.3%
Computer Assisted Audit Tools

Computer-assisted audit techniques (CAATs) or computer-assisted audit tools and techniques (CAATTs) are a growing field within the audit profession. CAATs are the practice of using computers to automate the audit processes. CAATs normally includes using basic office productivity software such as spreadsheet, word processors and text editing programs and more advanced software packages involving use statistical analysis and business intelligence tools. But also more dedicated specialized software are available. CAATs have become synonymous with data analytics in the audit process.

Audit functions formerly performed manually are now performed using standard financial accounting software, modified as necessary for a particular system. Generally, much of the same information is requested and analyzed as in a traditional audit. Once verified using computer techniques, data is retained so it can be used in other areas of the audit including error identification and segregation of transactions within accounts. Customized reports are generated by computer and a standard audit trail is maintained. Now more than ever before, these tools are being used throughout the industry to assist internal auditors in their search for irregularities in data files, to help internal accounting departments with more detailed analysis and to support the forensic accountant with extrapolating large amounts of data for further analysis and fraud detection.

Although CAATs have been around for years, accountants are finding it easier to use these techniques now to analyze large volumes of data for anomalies. And with advances in technology, it is simpler to obtain data files and have access to many of the improved tools on the market. The
average accountant no longer needs to know how to do computer programming to be able to identify, request and import the data for analysis. The accountant simply needs to be in a position to select the appropriate data files and then rely upon core skills to perform specific tests on that data.

Selecting the appropriate data file may sometimes be a little tricky. Generally, a meeting with the client, the client’s internal or external technology personnel and the addition of a Certified Information Technology Professional (CITP) credential holder to your audit team can definitely help with the appropriate data file identification process. Once you obtain the appropriate data files and import them into your CAATS tool, it is time for the analytics. Many of the tools on the market today include automated routines that perform common queries. In addition to the “included” routines, CAATS user groups are pretty common and can be found all over the Internet.

**Benford’s Second Order Summation Test**

The second-order test looks at relationships and patterns in data and is based on the digits of the differences between amounts that have been sorted from smallest to largest (ordered). The digit patterns of the differences are expected to closely approximate the digit frequencies of Benford’s Law. The second-order test gives few, if any, false positives in that if the results are not as expected (close to Benford), then the data do indeed have some characteristic that is rare and unusual, abnormal, or irregular.

The second of these new tests is called the summation test. The summation test looks for excessively large numbers in the data. The
summation test is an easy extension to the usual first-two digits test and it can be run in either Access or Excel. (MARK J. NIGRINI, 2011)

**Fraud Hotlines**

Fraud Hotline is an anonymous and confidential whistleblower reporting service for potential fraud, ethical issues, and other concerns. Reports may be submitted 24-hours a day by employees, volunteers, board members, and others within a registered organization using our secure online form or via our toll-free voicemail number. All information is conveyed directly to those within the organization as designated by the organization's management or the board of directors.