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IN REPLY REFER TO:
OTS 730.5

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MEMORANDUM FOR REGIONAL DIRECTORS, DCAA
HEADS OF PRINCIPAL STAFF ELEMENTS, HQ, DCAA

SUBJECT: Introducing Benford's Law Analytical Technique

Auditors should consider the use of Benford's Law digital analysis as a risk assessment tool. Benford's Law (First-Digit Law) refers to the frequency distribution of digits in many (but not all) sources of data. The audit profession developed this theory into a computer-assisted audit technique (CAAT), and uses it as part of risk assessments to identify unusual or suspicious cost patterns when evaluated against the expected norm. Benford's Law analysis should not be used alone, but in concert with other analytical procedures.

Benford's Law states that for a set of non-manipulated, naturally occurring numbers, the frequency of digits one through nine as the first digit should be expected. Most financial and accounting data conform to naturally occurring numbers, so by comparing the frequency of these first digits to Benford's frequency pattern, auditors may be able to identify irregularities and possible manipulations. The technique cannot be used to identify unallowable cost directly, but it can identify items of interest for additional review.

An overview of Benford's Law is attached to this memorandum. To learn more, please see our "Instructions for Using Benford's Law in DCAA Audits," located on the DCAA Intranet at:

https://infoserv.dcaaintra.mil/headquarters/O/OTS/Data_Mining/Documents/Instructions_for_Using_Benfords_Law_in_DCAA_Audits.pdf

DCAI training material related to this tool is presented in CMTL 1228, Lesson 22, Basic-Digits Tests; and in Course 5657, Mining Relational Databases with MS Access/SQL. The DCAA Power Tools in MS Excel has been modified to include a Benford's Law testing module, which includes graphics and a MAD (Mean Absolute Deviation) statistical measure. The MAD is a measure of how well the data being tested conforms to the Benford's predicted distribution. This new DCAA Power Tools feature will be 'pushed" to agency laptops within the next 30 days.

For questions on how to use this procedure, and other data analysis techniques, please contact our OTST data analysis team led by Steve Thorsted at email steve.thorsted@dcaa.mil; or contact Scott Standlee, OTST Branch Chief, at email scott.standlee@dcaa.mil.

/s/

Thomas J. Peters
Assistant Director, Operations

Attachment (a/s)
Distribution: E

BENFORD'S LAW

Benford's Law is a mathematical theory stating that leading digits in many (but not all) large datasets are distributed in a specific pattern. For example, Benford's Law predicts for each single leading digit (1 through 9), the leading digit "1" should occur about 30% of the time, while the leading digit "9" should occur about 5% of the time. This contrasts to an equal distribution of about 11% for each leading digit. Benford's law also covers the second digit, first two digits, last digit, and other combinations of digits. Benford's Law predicted frequencies are based on a logarithmic function. The following graph shows the frequency of the first leading digit predicted by Benford's Law.

1st Digit (d)	Probability (p)
1	0.30103
2	0.17609
3	0.12494
4	0.09691
5	0.07918
6	0.06695
7	0.05799
8	0.05115
9	0.04576

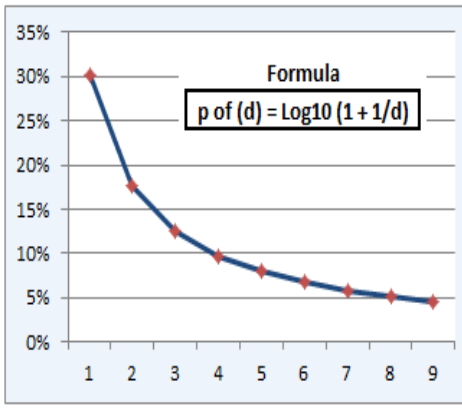

Table – Benford's Law First-Digit Probability

Benford's Law allows auditors to identify transactions that differ significantly from the expected frequency distribution. Further analysis of these transactions may lead to the identification of errors because altered numbers are not likely to follow Benford's Law. Auditors need to be aware that they cannot rely on the results of Benford's Law as the sole evidence leading to questioned cost. It is one of several analytical procedures that may indicate anomalies that require additional testing. Benford's Law should be used for risk assessment at the top level as well as lower levels such as account transactions.

Benford's Law applies to naturally occurring numbers. Benford's Law does not apply to all data sets, and the following limitations need to be considered.

- All of the transactions should measure the same attribute, i.e. all are dollar values, lengths, counts or other numeric attribute.
- There should be no established minimum or maximum value.
- The numbers should not be pre-assigned numbers such as telephone numbers, Social Security numbers, and account numbers.
- There should not be a "clustering" of values around a particular amount such as prices set by psychological thresholds.
- It does not work on small samples. A data set for bank account with 20 checks for the year is too small.
- The test typically won't capture a fraudster who manipulates one or very few transactions. Benford's testing works better when a sufficient number of billings or payments are manipulated enough to upset the predicted pattern.

Attachment