Sampling using Excel and Audit Commander

Audit Commander
Audit Guide
Data analysis made easier...
EZ-R Stats, LLC
The software described in this document may be freely downloaded and used without restriction. Additional information about the audit software is available at the web site http://ezrstats.com.

All comments and suggestions are welcome.
## Revision History

<table>
<thead>
<tr>
<th>Revision Number</th>
<th>Revision Date</th>
<th>Summary of Changes</th>
<th>Author</th>
</tr>
</thead>
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<tr>
<td>1.0</td>
<td>8-8-2009</td>
<td>Initial Version</td>
<td>M. Blakley</td>
</tr>
<tr>
<td>1.1</td>
<td>8-11-2009</td>
<td>Attribute sampling</td>
<td>M. Blakley</td>
</tr>
<tr>
<td>1.2</td>
<td>8-21-2009</td>
<td>Stratified Sampling</td>
<td>M. Blakley</td>
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Random Sequential Sampling

1 About this guide

This document is divided into the following chapters:

- Chapter 1 – Overview
- Chapter 2 – About sequential sampling
- Chapter 3 – Using Excel For Random Sequential Sampling (Unrestricted)
- Chapter 4 – Random Sequential Sampling with Audit Commander (Unrestricted)
- Chapter 5 – Stratified Sampling using Excel
- Chapter 6 – Stratified Sampling with Audit Commander

1.1 Who Should Use It

Auditors, researchers, business analysts and academics who use random sampling to perform their jobs.

- Auditors: can use the software to sample more efficiently
- Researchers: use the software for:
  - Random sampling
  - Statistical reports and charts
1.2 Typographical Conventions

This document uses the following typographical conventions:

- Command and option names appear in bold type in definitions and examples.
- Screen output and code samples appear in monospace type.

1.3 Purpose

The purpose of this monograph is to provide a practical guide to the use of random sequential sampling in order to make the sampling process more efficient.

Random sequential sampling is not a new concept, but has received very little attention. This may be due to the fact that to take maximum advantage of sequential sampling, an automated process is necessary. Hopefully, this guide will provide the information to do so.

The auditor does not need special computer skills in order to be able to take advantage of random sequential sampling.

Development of the software began in August 2005 when the author searched fruitlessly for a relatively easy to use, economical software package for random sampling. During its development, suggestions and improvements were made by a variety of audit practitioners.


1.4 Scope

The purpose of this guide is to explain the basis for sequential sampling and methods to implement it using software. This guide is for version 1.88 of the Audit Commander software.
1.5 Intended audience

The software is intended for use by both internal and external auditors, researchers, students learning random sampling, business analysts and anyone else interested in performing random sampling in a more efficient and effective manner.

1.6 Hardware requirements

At least 512 MB of memory (more if possible). Minimum disk space is 27 MB.

1.7 Software requirements

Works only in Windows XP, Vista or Windows 7. Requires ActiveX Data Objects which is part of SP1. (ActiveX Data Objects can be downloaded from the Microsoft web site at no charge)
2 Getting Started

2.1 Random sequential sampling

Sequential sampling differs from the more traditional methods of performing random sampling, yet provides the same results. In sequential sampling, there does not need to be any “up front” analysis or knowledge of the attributes of the data being sampled. There is no calculation of “required sample size”. Instead, sampling objectives are defined at the start of the process, and then small, “sequential” samples are taken and evaluated. If, after evaluating the cumulative results, the sampling objective has been achieved, the sampling process ends. If the sampling objective has not been achieved, then another small sample is taken and the process is repeated.

The advantages of sequential sampling include:

- No knowledge of the attributes of the population being tested are required
- No need to compute a “required sample size”
- No need to pre-select “spares” in the event that the sample size taken is too small
- Little or no chance of “over sampling” and thus spending unneeded time testing the samples

The disadvantages of sequential sampling include:

- Not applicable or practical in all instances
- Computationally intensive

However, in many cases the advantages of sequential sampling outweigh the disadvantages.
2.2 Organization of the guide

A small sample test dataset has been prepared and will be used for illustration of the sampling procedures. Two types of sampling will be illustrated:

1. Attribute sampling
2. Variable sampling

The sampling procedures will be illustrated using two software systems:

1. Microsoft Excel
2. Audit Commander 1.88

2.3 Sampling objectives

The sampling objectives will be identical for all three systems used. For the variable sample, a confidence level of 95% is desired, with a precision level of 5%.

For the attribute sample, a confidence level of 95% is also desired, with the same precision level of 5%. Note that although the examples use these confidence levels, any confidence level may be used.
3 Sequential Sampling with Excel (Unrestricted)

3.1 Description of data to be sampled

For this exercise, example data has been included on two Excel worksheets. One sheet is for variable sampling and is named “Sample Variable”. The other sheet is for attribute sampling and has been named “Sample Attribute”.

Shown below is a snapshot of the top of each sheet.

3.1.1 Variable sample data on worksheet “Sample Variable”

<table>
<thead>
<tr>
<th>Obs No</th>
<th>Sampled</th>
<th>Book Value</th>
<th>Audited Value</th>
<th>Random</th>
<th>Tran Date</th>
<th>Actual Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>209.37</td>
<td></td>
<td>0.1404</td>
<td>7/10/07</td>
<td>209.37</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>512.48</td>
<td></td>
<td>0.0341</td>
<td>5/23/07</td>
<td>512.48</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>324.26</td>
<td></td>
<td>0.1126</td>
<td>6/16/07</td>
<td>324.26</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>749.61</td>
<td></td>
<td>0.0428</td>
<td>5/19/07</td>
<td>749.61</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>103.9</td>
<td></td>
<td>0.6257</td>
<td>5/19/07</td>
<td>103.9</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>635.67</td>
<td></td>
<td>0.3944</td>
<td>5/3/07</td>
<td>635.67</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>123.25</td>
<td></td>
<td>0.2944</td>
<td>6/25/07</td>
<td>123.25</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>665.44</td>
<td></td>
<td>0.9755</td>
<td>7/5/07</td>
<td>620.91</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>540.02</td>
<td></td>
<td>0.5047</td>
<td>4/13/07</td>
<td>540.02</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>727.32</td>
<td></td>
<td>0.56</td>
<td>6/7/07</td>
<td>727.32</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>237.54</td>
<td></td>
<td>0.2611</td>
<td>6/21/07</td>
<td>237.54</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>104.63</td>
<td></td>
<td>0.7042</td>
<td>4/18/07</td>
<td>108.37</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>796.32</td>
<td></td>
<td>0.2072</td>
<td>7/7/07</td>
<td>796.32</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>864.74</td>
<td></td>
<td>0.3659</td>
<td>6/27/07</td>
<td>864.74</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>811.11</td>
<td></td>
<td>0.1485</td>
<td>4/16/07</td>
<td>811.11</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>142.15</td>
<td></td>
<td>0.9427</td>
<td>6/21/07</td>
<td>145.12</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>295.03</td>
<td></td>
<td>0.0622</td>
<td>7/10/07</td>
<td>295.03</td>
<td></td>
</tr>
</tbody>
</table>

As can be seen, the worksheet consists of seven columns as follows:

- Obs no – the observation number or assigned number for the population being tested.
Random Sequential Sampling

- Sampled – a blank column indicating whether the row has been selected for sampling
- Book Value – the recorded numeric amount to be tested
- Audited value – the amount that the transaction should have been, based upon the auditor’s audit tests performed when the item was sampled and reviewed
- Random number – a random number between 0 and 1 that was assigned using the Excel random function “=rand()”
- Tran date – a transaction date, for reference purposes only
- Actual value – this is the value that would be obtained during an audit, i.e. the audited value. Note that in an actual audit this information would not be available, but is shown here only for educational and illustrative purposes.

3.1.2 Attribute sample data on worksheet “Sample Attribute”

<table>
<thead>
<tr>
<th>Obs No</th>
<th>Sampled</th>
<th>Signature</th>
<th>Document</th>
<th>Approval</th>
<th>Random</th>
<th>Tran Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.05376</td>
<td>7/10/07</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0341</td>
<td>5/23/07</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1126</td>
<td>6/16/07</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0428</td>
<td>5/19/07</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.6257</td>
<td>5/19/07</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3944</td>
<td>5/3/07</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2944</td>
<td>6/25/07</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9755</td>
<td>7/5/07</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5047</td>
<td>4/13/07</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.56</td>
<td>6/7/07</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2611</td>
<td>6/21/07</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.7042</td>
<td>4/18/07</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2072</td>
<td>7/7/07</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3659</td>
<td>6/27/07</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1485</td>
<td>4/16/07</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9427</td>
<td>6/21/07</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0622</td>
<td>7/10/07</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.863</td>
<td>5/27/07</td>
</tr>
</tbody>
</table>

As can be seen, the worksheet consists of seven columns as follows:
## Random Sequential Sampling

- Obs no – the observation number or assigned number for the population being tested.

- Sampled – a blank column indicating whether the row has been selected for sampling.

- Signature – A blank column used to record if the selected attribute “signature” exists and was appropriate.

- Document – A blank column used to record if the selected attribute “signature” exists and was appropriate.

- Approval – A blank column used to record if the selected attribute “signature” exists and was appropriate.

- Random – A random number between 0 and 1 generated using the Excel function “=rand()”.

- Tran date – A date used for reference purposes only.

### 3.2 Variable sampling

#### 3.2.1 Sampling the first group

The first step in the procedure is to define the sampling objectives, which are the same for all sampling systems tested, i.e. 95% confidence and 5% precision. The next step is to assign a random number between 0 and 1 to each item in the population. In this example, the Excel random number function has been used, although it is possible to use other methods to assign random numbers.

The next step is to sort the data by the random numbers assigned. Order may be either ascending or descending. For purposes of this illustration we select ascending order.

The next step is to select a small starting number of transactions. The selections must be made sequentially based upon the sorted items to be tested in the population.

We will select the first 150 items and then make an audit determination of what the audited value is, i.e. after reviewing the documents and performing other tests on the items in the sample make a determination of the audited values for each of the first 150 items.
Random Sequential Sampling

Note that for this example, the “audited value” has already been specified in the rightmost column. So we can copy those values over to the column “Audited Value”. The worksheet now appears as follows:

<table>
<thead>
<tr>
<th>Obs No</th>
<th>Sampled</th>
<th>Book Value</th>
<th>Audited Value</th>
<th>Random</th>
<th>Tran Date</th>
<th>Actual Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>232 X</td>
<td>979.08</td>
<td>979.08</td>
<td>0.001</td>
<td>6/22/07</td>
<td>979.08</td>
<td></td>
</tr>
<tr>
<td>432 X</td>
<td>838.61</td>
<td>838</td>
<td>0.002</td>
<td>5/28/07</td>
<td>838.61</td>
<td></td>
</tr>
<tr>
<td>253 X</td>
<td>64.65</td>
<td>64.65</td>
<td>0.0044</td>
<td>6/10/07</td>
<td>64.65</td>
<td></td>
</tr>
<tr>
<td>368 X</td>
<td>272.39</td>
<td>270</td>
<td>0.0053</td>
<td>4/30/07</td>
<td>272.39</td>
<td></td>
</tr>
<tr>
<td>405 X</td>
<td>334.11</td>
<td>0</td>
<td>0.0085</td>
<td>7/11/07</td>
<td>334.11</td>
<td></td>
</tr>
<tr>
<td>221 X</td>
<td>115.73</td>
<td>110</td>
<td>0.0108</td>
<td>5/16/07</td>
<td>115.73</td>
<td></td>
</tr>
<tr>
<td>270 X</td>
<td>355.41</td>
<td>0</td>
<td>0.0108</td>
<td>7/16/07</td>
<td>355.41</td>
<td></td>
</tr>
<tr>
<td>227 X</td>
<td>32.37</td>
<td>32.37</td>
<td>0.0161</td>
<td>4/22/07</td>
<td>32.37</td>
<td></td>
</tr>
<tr>
<td>288 X</td>
<td>140.56</td>
<td>140</td>
<td>0.0191</td>
<td>4/23/07</td>
<td>140.56</td>
<td></td>
</tr>
<tr>
<td>34 X</td>
<td>987.76</td>
<td>987.76</td>
<td>0.0252</td>
<td>4/23/07</td>
<td>987.76</td>
<td></td>
</tr>
<tr>
<td>132 X</td>
<td>285.93</td>
<td>270</td>
<td>0.0256</td>
<td>6/28/07</td>
<td>285.93</td>
<td></td>
</tr>
<tr>
<td>360 X</td>
<td>169.05</td>
<td>169.05</td>
<td>0.0259</td>
<td>6/13/07</td>
<td>169.05</td>
<td></td>
</tr>
<tr>
<td>313 X</td>
<td>569.69</td>
<td>560</td>
<td>0.0268</td>
<td>7/10/07</td>
<td>569.69</td>
<td></td>
</tr>
<tr>
<td>298 X</td>
<td>855.55</td>
<td>855.35</td>
<td>0.0269</td>
<td>6/9/07</td>
<td>855.35</td>
<td></td>
</tr>
<tr>
<td>345</td>
<td>684.14</td>
<td>0.0322</td>
<td>6/22/07</td>
<td>684.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>216</td>
<td>901.32</td>
<td>0.0328</td>
<td>5/27/07</td>
<td>901.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>512.48</td>
<td>0.0341</td>
<td>5/23/07</td>
<td>512.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our audited values are now contained in column “D”, rows 2 through 151.

3.2.2 Assessing the first group

The first group of sampled transactions has their audited values in column “D”. We can use the Excel function “STDEV” to determine the sample standard deviation. To simplify and clarify the formulae used, set up a “named range” for the sampled values. In this instance, the sampled values range will be called “sampled” and is defined as the cells from D2:d151. Similarly, a named range “population” is established for the entire population. The formula for the standard deviation is then “=STDEV(sampled)”. We also use the COUNT function to determine the number of items in the population. The formula is “=COUNT(population)”. We can also determine the average (mean) value for the sampled items using the Excel AVERAGE function – for which the formula is “=AVERAGE(sampled)”.

---

[Note: The image contains a table with data entries and a paragraph explaining the sample standard deviation calculation using Excel functions.
Random Sequential Sampling

The point estimate of the value for the entire population will simply be the average times the number of items which can be obtained by multiplying the two values we obtained, i.e. use the formula 

\[-=\text{AVERAGE(sampled)} * \text{COUNT(population)}.\]

The confidence interval at 95% confidence is the Student’s t-value using the sample count – 1 degrees of freedom. In Excel, the formula for the Student’s t-value would be

\[-=\text{TINV(.05,count(sampled)-1)}.\]  
The standard error of the mean is the sample standard deviation divided by the square root of the sample size or

\[-\text{STDEV(sampled)/SQRT(COUNT(sampled))}.\]  
A 95% confidence interval would then be obtained by multiplying this amount by the population count (population) and multiplying that by the t-value (TINV(.05,count(sampled)-1)). For samples which represent more than 5% of the population size, a finite population correction factor must be applied. This factor is the square root of the population size minus the sample size divided by the population size minus one. In Excel, the formula is 

\[-=\text{SQRT((COUNT(population) – COUNT(sampled))/(COUNT(population) – 1))}.\]  
So the formula for the interval would be:

\[-=(\text{STDEV(sampled)/SQRT(COUNT(sampled))})* \text{TINV(.05,count(sampled)-1)} * \text{count(population)}* \text{SQRT((COUNT(population) – COUNT(sampled))/(COUNT(population) – 1)}].\]

Once all the formulae are established, it becomes very easy to compute all these amounts. All that is required is changing the specification for the named range “sampled”.

Our first test is for 150 items. Once the samples are evaluated (audited), the following results are obtained:

<table>
<thead>
<tr>
<th>Mean</th>
<th>494.36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std Dev</td>
<td>283.23</td>
</tr>
<tr>
<td>Count</td>
<td>150</td>
</tr>
<tr>
<td>Pop</td>
<td>432.00</td>
</tr>
<tr>
<td>PE</td>
<td>213,563</td>
</tr>
<tr>
<td>Corr</td>
<td>0.81</td>
</tr>
<tr>
<td>SE Mean</td>
<td>23.13</td>
</tr>
<tr>
<td>t-value</td>
<td>1.97601</td>
</tr>
<tr>
<td>Interval</td>
<td>15,968.37</td>
</tr>
<tr>
<td>Percent</td>
<td>7.48%</td>
</tr>
<tr>
<td>LL</td>
<td>197,595</td>
</tr>
<tr>
<td>UL</td>
<td>229,531</td>
</tr>
</tbody>
</table>
Random Sequential Sampling

The confidence interval percentage is 7.48% which is too wide. Thus we need to test more samples. Shown below are the results for the selection of an additional 85 samples (235 in total). Note that it is fairly easy to do the calculations in Excel, as the only thing that needs to be changed is the definition of the sampled range, i.e. change from D2:d151 to d2:d236.
Random Sequential Sampling

The results achieved are as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>491.94</td>
</tr>
<tr>
<td>Std Dev</td>
<td>283.62</td>
</tr>
<tr>
<td>Count</td>
<td>235</td>
</tr>
<tr>
<td>Pop</td>
<td>432.00</td>
</tr>
<tr>
<td>PE</td>
<td>212,519</td>
</tr>
<tr>
<td>Corr</td>
<td>0.68</td>
</tr>
<tr>
<td>SE Mean</td>
<td>18.50</td>
</tr>
<tr>
<td>t-value</td>
<td>1.97015</td>
</tr>
<tr>
<td>Interval</td>
<td>10,645.98</td>
</tr>
<tr>
<td>Percent</td>
<td>5.01%</td>
</tr>
<tr>
<td>LL</td>
<td>201,873</td>
</tr>
<tr>
<td>UL</td>
<td>223,165</td>
</tr>
</tbody>
</table>

At this point we achieved our sampling objectives, i.e. a precision level of 5% has been obtained.
3.3 Attribute Sampling

Evaluating the results of attribute sampling using Excel is difficult, to say the least. An estimate for the results can be computed using the following formulae. The error rate is computed as the number of errors found in the sample divided by the sample size, i.e. (errors_found / sample_size). The point estimate is simply the error rate (errors_found / sample_size) * population_size. The error rate is generally notated as “p”.

The sample size is generally designated as “n”. The population size is generally designated as “N”. The formula for the universe standard error is “=SQRT((p*(1-p))/(n-1) * (1 – (n/N)))”. A “z-score” can be computed using Excel’s inverse normal function. For a 95% precision, the formula would be “=NORMINV(.975,0,1)” which results in a value of 1.959963.

To compute the upper limit, determine the interval size as the universe standard error times the z-score added to the point estimate. For the lower limit, simply subtract the interval size from the point estimate.

The formula is shown below:

\[
\text{For universe total: Standard Error} = N \cdot \sqrt{\frac{\hat{p}(1-\hat{p})}{n-1}} \left(1 - \frac{n}{N}\right).
\]

However, this technique yields only approximations, which may have significant errors in certain cases. The exact approach, which is used by RAT-STATS, is based on the formulae published in the following article. John P. Buonaccorsi (1987), “A Note on Confidence Intervals for Proportions in Finite Populations,” The American Statistician, Vol. 41, No. 3, 215-218.

The formula is computationally intensive and requires the use of the mathematical “Combinations” function. Although Excel has the function (“=COMBIN(m,n)”), the process to make the computations would be difficult to perform using a spreadsheet alone.
Random Sequential Sampling

Bottom line – Excel can compute only a rough estimate of attribute sampling values.

The formulae referenced in the article to compute the upper limit is:

$$ TAIL = (1 - .90)/2 = .05. $$

**Upper Limit:** Let $k_2 = \text{largest value of } k \text{ for which}$$

$$ \sum_{i=0}^{x} \frac{{k \choose i} {N - k \choose n - i}}{C_n^N} > .05 $$

where $N = \text{universe size}$

$n = \text{sample size}$

$k = \text{total number of universe items in error}$

$x = \text{number of sample items in error}$

The computation for the lower limit is similar, as shown below:

**Lower Limit:** Let $k_1 = \text{smallest value of } k \text{ for which}$$

$$ \sum_{i=x}^{n} \frac{{k \choose i} {N - k \choose n - i}}{C_n^N} > .05 $$
Sequential sampling with Audit Commander involves opening a form and selecting values from the drop down menus. Note that no “pre sorting” is required, and it is possible to specify both the work sheet and the columns to be tested.

### 4.1 Macro Used for Variable Sampling

```
Dim oewm As New cEWM
Dim sInfile As String
Dim sSQL As String
sInfile = "c:\test\sample\Example data.xls"
oewm.ChartFile = "c:\test\sample\t-stopgov.png"
oewm.Cmd = "stopgov"
oewm.Colstring = "[sampled], [audited value]"
oewm.Table = "Sample Variable$" ' req by oewm
' oewm.SQL = "select county, mileage, expense from [maintenance$];"
oewm.Filein = sInfile
oewm.FileOut = "c:\test\sample\t-stopgov-report.txt"
' oewm.Parm1 = ".95"
oewm.Title = "Test Stop Go V"
(MsgBox oewm.ShowValues
```
4.2 Text Report

The following text report is output by Audit Commander to summarize the results of the sampling.

Sampling results:
Sample size 64
Sample mean 460.05
Sample Std Dev 302.48
Population size 432
Point estimate: 198,740.99

Values at 95% confidence
  t-value used 1.99834
  Lower limit 168,579.74
  Upper Limit 228,902.24
  t-value 1.99834

Values at 98% confidence
  Lower limit 162,713.53
  Upper Limit 234,768.45
  t-value 2.38701

Values at 90% confidence
  Lower limit 173,544.46
  Upper Limit 223,937.53
  t-value 1.66940

Values at 80% confidence
  Lower limit 179,193.34
  Upper Limit 218,288.65
  t-value 1.29513
4.3 Chart Produced

The following chart is output by the Audit Commander to show the results of sampling as a chart. These results reflect the intervals at four levels of confidence – 80%, 90%, 95% and 98% confidence.

The chart shows the ranges of values. On the left, the upper and lower intervals at the top and bottom are for the 98% confidence levels. The two lines between are the upper and lower intervals at the 95% confidence level.

The chart on the right side of the report shows the values at 80% and 90% confidence levels. The outside upper and lower confidence intervals are the values at the 90% confidence level, with the values inside showing the amounts at the 80% confidence level.
Random Sequential Sampling

4.4 Macro Used for Attribute Sampling

Audit Commander uses the same formulae as RAT-STATS for attribute sampling, i.e. the formula published in the Journal article previously mentioned.

```
Dim oewm As New cEWM
Dim sInfile As String
Dim sSQL As String
sInfile = "c:\test\sample\Example data.xls"
oewm.ChartFile = "c:\test\sample\t-stopgoa.png"
oewm.Cmd = "stopgoa"
oewm.Colstring = "[sampled], [Signature]"
oewm.Table = "Sample Attribute$" ' req by oewm
oewm.Filein = sInfile
oewm.FileOut = "c:\test\sample\t-stopgoa-report.txt"
oewm.Title = "Attribute testing of signatures"
Call oewm.RunCmd
If oewm.ErrNo <> 0 Then
    MsgBox oewm.errmsg
    MsgBox oewm.ErrDescription
End If
Set oewm = Nothing
```

4.5 Text Report

The following text report is output by Audit Commander to summarize the results of the attribute sampling.
Random Sequential Sampling

Sampling results:
Sample size 98
Errors 4
Error rate 4.08%
Population size 3027
Confidence used 95.00%
Z-score 1.95996
Point estimate: 124
Lower limit 35
Upper Limit 303
Confidence used 98.00%
Lower limit 27
Upper Limit 341
Confidence used 90.00%
Lower limit 44
Upper Limit 272
Confidence used 80.00%
Lower limit 55
Upper Limit 239
The chart shows the ranges of values. On the left, the upper and lower intervals at the top and bottom are for the 98% confidence levels. The two lines between are the upper and lower intervals at the 95% confidence level.

The chart on the right side of the report shows the values at 80% and 90% confidence levels. The outside upper and lower confidence intervals are the values at the 90% confidence level, with the values inside showing the amounts at the 80% confidence level.
4.7 Computing Upper and Lower Limits using a macro

If only the limits need to be computed (i.e. no report or charts), the upper and lower limits can be computed directly using a macro such as shown below:

```vba
Dim nsamp As Long
Dim nPop As Long
Dim nErrs As Long
Dim dPrec As Double
Dim iuL As Long
Dim iLL As Long
Dim sMsg As String
Dim oEWM As New cEWM

nsamp = 98
nPop = 3027
nErrs = 4
dPrec = 0.8

iuL = oEWM.ul(nsamp, nPop, nErrs, dPrec)
iLL = oEWM.ll(nsamp, nPop, nErrs, dPrec)

sMsg = "Attribute testing: " & vbCrLf
sMsg = sMsg & "Population: " & nPop & vbCrLf
sMsg = sMsg & "Sample size: " & nsamp & vbCrLf
sMsg = sMsg & "Errors: " & nErrs & vbCrLf
```

```vba
sMsg = sMsg & "Upper limit: " & iuL & vbCrLf
sMsg = sMsg & "Lower limit: " & iLL & vbCrLf
```

```vba
Print sMsg
```
Random Sequential Sampling

sMsg = sMsg & "Precision: " & dPrec & vbCrLf
sMsg = sMsg & "LL: " & iLL & vbCrLf
sMsg = sMsg & "UL: " & iuL & vbCrLf
Set oEWM = Nothing
MsgBox sMsg
5 Stratified Sampling with Excel

5.1 Variable Sampling

The process to perform stratified variable assessments of sample results in Excel is similar to that for unrestricted sampling. The primary difference is that additional computations need to be made for each strata.

5.1.1 Point estimate

The end objective is the same, i.e. determine a point estimate and determine a confidence interval. The point estimate for stratified variable sampling is simply the sum of the point estimates for each strata.

\[ \bar{y}_{st} = \left( \frac{N_1}{N} \right) \bar{y}_1 + \left( \frac{N_2}{N} \right) \bar{y}_2 + \cdots + \left( \frac{N_L}{N} \right) \bar{y}_L \]

5.1.2 Population Variance

The estimated variance for the population is computed using the following formula:

\[ \nu(\bar{y}_{st}) = \frac{1}{N^2} \sum_{i=1}^{L} \frac{N_i^2}{N_i} \left( \frac{N_i - n_i}{N_i} \right) \frac{s_i^2}{n_i} \]

where \( n_i = \) number of sampled items in i-th stratum

\( s_i^2 = \) sample variance for i-th stratum

Although this formula looks imposing, it can be broken down into small components, each of which is readily calculated using Excel. The starting point is the calculation of the sample variance for each stratum. To compute this amount using Excel, a series of columns can be set
Random Sequential Sampling

up with each strata shown on a separate row. Begin by computing the count, average and standard deviation for each strata using the following built in Excel functions:

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Excel function</th>
<th>Symbol in formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>&quot;=Count(range)&quot;</td>
<td>n I</td>
</tr>
<tr>
<td>Average</td>
<td>&quot;=Average(range)&quot;</td>
<td>Y bar i</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>&quot;=Stdev(range)&quot;</td>
<td>s i</td>
</tr>
</tbody>
</table>

Now that we have the standard deviation and counts for each strata, we can then perform the computations step by step. In the Excel sheet shown below, the first column is the stratum name or number, the second column is the number of items sampled from each stratum followed by the average and standard deviation. Next is the count of all items in the stratum.

The remaining columns are completed as follows.

The point estimate (PE) is simply the average times the number of items in the entire stratum. The remaining columns are used to compute the value of the formula which can be expressed as estimated population variance = A \cdot \text{sum}( B \cdot C \cdot D) where “A” is 1 / N squared, “B” is the number of items in each strata etc. Thus the three columns to the right of the column labeled “PE” are the “B”, “C” and “D” of the formula. Once we have each of these three amounts, we can then use Excel to multiply them together. This provides the value in the right most column. All of the values in the rightmost column can then be totaled and this total divided by the entire population count (N) squared.

<table>
<thead>
<tr>
<th>Strata</th>
<th>n</th>
<th>Average</th>
<th>Std dev</th>
<th>N</th>
<th>PE</th>
<th>s^2/ni</th>
<th>(Ni-ni)/Ni</th>
<th>Ni^2</th>
<th>G<em>H</em>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49</td>
<td>8590.51</td>
<td>17056.93</td>
<td>51</td>
<td>438115.78</td>
<td>5937527.39</td>
<td>0.04</td>
<td>2601</td>
<td>805627793</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>1486.85</td>
<td>2541.63</td>
<td>267</td>
<td>396988.82</td>
<td>215330.23</td>
<td>0.89</td>
<td>7129</td>
<td>13625881685</td>
</tr>
<tr>
<td>3</td>
<td>124</td>
<td>563.00</td>
<td>870.69</td>
<td>4,512</td>
<td>2540253.45</td>
<td>6113.77</td>
<td>0.97</td>
<td>20358144</td>
<td>121044444083</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>210.14</td>
<td>267.69</td>
<td>1,724</td>
<td>362279.06</td>
<td>2388.67</td>
<td>0.89</td>
<td>2972176</td>
<td>6976000315</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>179.64</td>
<td>187.17</td>
<td>2,074</td>
<td>372578.20</td>
<td>1167.81</td>
<td>0.99</td>
<td>4301476</td>
<td>4950657288</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>19.15</td>
<td>42.21</td>
<td>5,539</td>
<td>92416.12</td>
<td>59.38</td>
<td>0.99</td>
<td>23280625</td>
<td>1373775814</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>11.43</td>
<td>23.55</td>
<td>12</td>
<td>81336.73</td>
<td>18.48</td>
<td>1.00</td>
<td>50680996</td>
<td>931341609</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
<td>1674.00</td>
<td>1283.20</td>
<td>12</td>
<td>20087.97</td>
<td>137215.90</td>
<td>0.00</td>
<td>144</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>30</td>
<td>226.67</td>
<td>501.19</td>
<td>1,489</td>
<td>337513.36</td>
<td>8372.93</td>
<td>0.98</td>
<td>2271721</td>
<td>18189788402</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>174.20</td>
<td>273.09</td>
<td>1,922</td>
<td>334805.35</td>
<td>2486.61</td>
<td>0.98</td>
<td>3694084</td>
<td>9040185400</td>
</tr>
<tr>
<td>11</td>
<td>30</td>
<td>54.46</td>
<td>120.32</td>
<td>5,539</td>
<td>301672.40</td>
<td>482.54</td>
<td>0.99</td>
<td>30680521</td>
<td>14724396938</td>
</tr>
<tr>
<td>12</td>
<td>31</td>
<td>33.14</td>
<td>51.05</td>
<td>24,790</td>
<td>821430.24</td>
<td>84.07</td>
<td>1.00</td>
<td>61454100</td>
<td>51597546090</td>
</tr>
<tr>
<td>13</td>
<td>47</td>
<td>21.47</td>
<td>72.39</td>
<td>72,369</td>
<td>1554104.26</td>
<td>15.73</td>
<td>1.00</td>
<td>8232327161</td>
<td>61372096090</td>
</tr>
<tr>
<td>Totals</td>
<td>503</td>
<td>126,688</td>
<td>7653582.75</td>
<td>325382973046</td>
<td>20.273273</td>
<td>60.4128469</td>
<td>4.502585116</td>
<td>-1.959962787</td>
<td>-8.824899275</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LL 51.58794765</td>
<td>6535574</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>UL 69.2377462</td>
<td>8771592</td>
<td></td>
</tr>
</tbody>
</table>

In this example this result is 20.2732. This is the population variance.
To obtain our confidence limits, we would then use the following formula:

\[ \hat{T} \pm Z_{0.025} \sqrt{\nu(\hat{T})} \]

The square root of the population variance is 4.502585. The z-score can be computed using the Excel formula “=NORMINV((1+conf)/2,0,1). For a confidence of 95% this yields a value of 1.95996. Thus, in this example, the interval would be 8.8248 which is the product of the two amounts. This amount would then be added to (or subtracted from) the average value. These amounts would then be multiplied by the entire population counts (in this example 126,698 to arrive at the upper and lower confidence levels (here 8,771,592 and 6,535,574.

In the example shown, the sample sizes were selected arbitrarily. In some cases it may be preferable to optimize these sample sizes in order to obtain the greatest precision for the least sample size.

### 5.1.3 Optimizing the sample

In some cases it is desirable to optimize the number of samples selected from each strata in order to get the most “bang for the buck” if the number of samples to be taken is a fixed, predetermined number.

There are at least two types of optimization that can be performed:

1. The cost for the selection of a sample in a strata is known, or
2. The cost is assumed to be the same for each strata (or unknown)

The formula to compute the optimal number of samples for each strata when the cost is known is as follows:

The computations can readily be done using Excel by setting up multiple columns.
### Random Sequential Sampling

<table>
<thead>
<tr>
<th>Stratum</th>
<th>N</th>
<th>Std Dev</th>
<th>Sample Cost</th>
<th>Nh * sh</th>
<th>Sqrt(ch)</th>
<th>E/F</th>
<th>Optimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wake County</td>
<td>5367</td>
<td>21.65</td>
<td>1</td>
<td>116195.55</td>
<td>1.00</td>
<td>116195.55</td>
<td>32</td>
</tr>
<tr>
<td>New Hanover</td>
<td>345</td>
<td>18.65</td>
<td>3</td>
<td>6434.25</td>
<td>1.73</td>
<td>3714.82</td>
<td>1</td>
</tr>
<tr>
<td>Mecklenberg</td>
<td>756</td>
<td>19.21</td>
<td>2</td>
<td>14522.76</td>
<td>1.41</td>
<td>10269.14</td>
<td>3</td>
</tr>
<tr>
<td>Person</td>
<td>24</td>
<td>24.56</td>
<td>1.5</td>
<td>589.44</td>
<td>1.22</td>
<td>481.28</td>
<td>0</td>
</tr>
<tr>
<td>Orange</td>
<td>654</td>
<td>17.23</td>
<td>1.5</td>
<td>11268.42</td>
<td>1.22</td>
<td>9200.63</td>
<td>3</td>
</tr>
<tr>
<td>Durham</td>
<td>1298</td>
<td>45.32</td>
<td>2</td>
<td>58825.36</td>
<td>1.41</td>
<td>41595.81</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Totals</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td></td>
<td>181457.22</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

Required Sample size: 50

If the cost is the same for all strata then the following formula can be used:

An alternative is to use the same formula and then just use a cost of ‘1’ for all strata.
5.2 Stratified Attribute Sampling

5.2.1 Point estimate

The end objective is the same, i.e. determine a point estimate and determine a confidence interval. The point estimate for stratified variable sampling is simply the sum of the point estimates for each strata. The point estimate for a strata is the percentage of attributes identified in the sample multiplied by the number of rows in the strata, and rounded to the nearest integer. The point estimate for the entire population is then the sum of all the point estimates for each strata.

A determination of the point estimate using Excel is illustrated in the figure below:

<table>
<thead>
<tr>
<th>Stratum</th>
<th>N</th>
<th>n</th>
<th>Count</th>
<th>p</th>
<th>Point Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wake County</td>
<td>5,367</td>
<td>57</td>
<td>4</td>
<td>7.02%</td>
<td>377</td>
</tr>
<tr>
<td>New Hanover</td>
<td>345</td>
<td>6</td>
<td>1</td>
<td>16.67%</td>
<td>58</td>
</tr>
<tr>
<td>Mecklenberg</td>
<td>756</td>
<td>15</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Person</td>
<td>24</td>
<td>2</td>
<td>1</td>
<td>50.00%</td>
<td>12</td>
</tr>
<tr>
<td>Orange</td>
<td>654</td>
<td>3</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Durham</td>
<td>1,298</td>
<td>15</td>
<td>2</td>
<td>13.33%</td>
<td>173</td>
</tr>
<tr>
<td>Totals</td>
<td>8,444</td>
<td>98</td>
<td>8</td>
<td></td>
<td>620</td>
</tr>
<tr>
<td>Point estimate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.34%</td>
</tr>
</tbody>
</table>

The formula used is:

\[ \hat{p} = \sum_{i=1}^{L} \left( \frac{N_i}{N} \right) \hat{p}_i \]
### 5.2.2 Population Variance

The estimated variance for the population is computed based upon the estimated sample variance for each strata using the following formula:

\[
SE(\hat{p}_i) = \sqrt{\frac{N_i - n_i}{N_i} \cdot \hat{p}_i (1 - \hat{p}_i) \cdot \frac{n_i}{n_i - 1}}
\]

The overall population variance is then estimated using the following formula:

\[
SE(\hat{p}) = \sqrt{\sum_{i=1}^{L} \left( \frac{N_i}{N} \right)^2 \cdot [SE(\hat{p}_i)]^2}
\]

These amounts can be computed readily in Excel. The process is best illustrated by breaking up the formula into small components and then combining the amounts to obtain the final calculation.

An illustration of the process to compute the population variance using Excel is illustrated in the figure below.

<table>
<thead>
<tr>
<th>Stratum</th>
<th>N</th>
<th>n</th>
<th>Count</th>
<th>p</th>
<th>(1-p)</th>
<th>Fraction (E*F)/(C-1)</th>
<th>(N-n/N)</th>
<th>Square root (G*H)</th>
<th>(N/Total)</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wake County</td>
<td>5,367</td>
<td>57</td>
<td>4</td>
<td>7.02%</td>
<td>92.98%</td>
<td>0.12%</td>
<td>98.94%</td>
<td>3.40%</td>
<td>63.56%</td>
<td>2.16%</td>
</tr>
<tr>
<td>New Hanover</td>
<td>345</td>
<td>6</td>
<td>1</td>
<td>16.67%</td>
<td>83.33%</td>
<td>2.78%</td>
<td>98.26%</td>
<td>16.52%</td>
<td>4.09%</td>
<td>0.68%</td>
</tr>
<tr>
<td>Mecklenberg</td>
<td>756</td>
<td>15</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00%</td>
<td>98.02%</td>
<td>0.00%</td>
<td>8.95%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Person</td>
<td>24</td>
<td>2</td>
<td>1</td>
<td>50.00%</td>
<td>50.00%</td>
<td>25.00%</td>
<td>91.67%</td>
<td>47.87%</td>
<td>0.28%</td>
<td>0.14%</td>
</tr>
<tr>
<td>Orange</td>
<td>654</td>
<td>3</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00%</td>
<td>99.54%</td>
<td>0.00%</td>
<td>7.75%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Durham</td>
<td>1,298</td>
<td>15</td>
<td>2</td>
<td>13.33%</td>
<td>86.67%</td>
<td>0.83%</td>
<td>98.84%</td>
<td>9.03%</td>
<td>15.37%</td>
<td>1.39%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>8,444</td>
<td>98</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.36%</td>
</tr>
</tbody>
</table>

Standard Error 4.36%
Confidence 95.00%
Z-score 1.95996
Interval 0.08541
Point estimate 8.16%
Upper 16.70%
Lower -0.38%

When the lower limit is computed as less than zero, it is then changed to zero.
6 Stratified Sampling with Audit Commander

Sequential sampling with Audit Commander involves opening a form and selecting values from the drop down menus. Note that no “pre sorting” is required, and it is possible to specify both the work sheet and the columns to be tested.

6.1 Macro Used for Variable Sampling

```vba
Dim oewm As New cEWM
Dim sMsg As String
Dim sColstring As String

oewm.Filein = "c:\test\ewp\Neyman v3.xls"

oewm.Cmd = "svacc"

oewm.FileOut = "c:\test\cm\report\t-33.txt"

sColstring = "[examined]"

sColstring = sColstring & ",[stratum]"

sColstring = sColstring & ",[selected]"

oewm.Colstring = sColstring

oewm.LocalCol = "stratum"

oewm.Table = "Neyman$"

'number of columns

oewm.Parm1 = "45"

oewm.Parm2 = "0.95"
```
6.2 Text Report

The following text report is output by Audit Commander to summarize the results of the sampling. (Txt report has been imported into Excel for ease of viewing).

<table>
<thead>
<tr>
<th>Strata</th>
<th>N</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Point Estimate</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>345</td>
<td>2</td>
<td>62.46</td>
<td>0</td>
<td>21,548.70</td>
<td>21,548.70</td>
<td>21,548.70</td>
</tr>
<tr>
<td>2</td>
<td>337</td>
<td>2</td>
<td>113.4</td>
<td>0</td>
<td>38,214.12</td>
<td>38,214.12</td>
<td>38,214.12</td>
</tr>
<tr>
<td>3</td>
<td>696</td>
<td>7</td>
<td>295.5</td>
<td>55.04</td>
<td>205,670.98</td>
<td>130,586.75</td>
<td>280,755.21</td>
</tr>
<tr>
<td>4</td>
<td>1431</td>
<td>15</td>
<td>511.84</td>
<td>29.35</td>
<td>732,443.04</td>
<td>650,134.56</td>
<td>814,751.52</td>
</tr>
<tr>
<td>5</td>
<td>2213</td>
<td>32</td>
<td>629.45</td>
<td>70.57</td>
<td>1,392,962.48</td>
<td>1,086,882.71</td>
<td>1,699,042.24</td>
</tr>
<tr>
<td>6</td>
<td>691</td>
<td>13</td>
<td>895.59</td>
<td>62.84</td>
<td>618,853.22</td>
<td>703,954.90</td>
<td>533,751.55</td>
</tr>
<tr>
<td>All</td>
<td>5713</td>
<td>71</td>
<td>589.9</td>
<td>54.94</td>
<td>3,370,088.24</td>
<td>2,754,943.74</td>
<td>3,985,232.74</td>
</tr>
</tbody>
</table>

Neyman Allocation report

<table>
<thead>
<tr>
<th>Strata</th>
<th>N</th>
<th>Std</th>
<th>Amt</th>
<th>Pct</th>
<th>Samp Size</th>
<th>Next</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>345</td>
<td>28.64</td>
<td>9,880.94</td>
<td>3.36%</td>
<td>2</td>
<td>-343</td>
</tr>
<tr>
<td>2</td>
<td>337</td>
<td>29.2</td>
<td>9,841.66</td>
<td>3.35%</td>
<td>2</td>
<td>-335</td>
</tr>
<tr>
<td>3</td>
<td>696</td>
<td>59.11</td>
<td>41,138.89</td>
<td>13.99%</td>
<td>6</td>
<td>-690</td>
</tr>
<tr>
<td>4</td>
<td>1431</td>
<td>36.96</td>
<td>52,886.43</td>
<td>17.99%</td>
<td>8</td>
<td>-1,423</td>
</tr>
<tr>
<td>5</td>
<td>2213</td>
<td>63.48</td>
<td>140,484.00</td>
<td>47.78%</td>
<td>21</td>
<td>-2,192</td>
</tr>
<tr>
<td>6</td>
<td>691</td>
<td>57.62</td>
<td>39,817.29</td>
<td>13.54%</td>
<td>6</td>
<td>-685</td>
</tr>
</tbody>
</table>
Random Sequential Sampling

Macro Used for Stratified Attribute Sampling

Audit Commander can assess stratified attribute sampling using either a menu or a macro. The macro used is shown below (which provides the same results as the form based system).

```
Dim oewm As New cEWM
Dim sMsg As String
Dim sColstring As String

oewm.Filein = "c:\test\ewp\Neyman v3.xls"

oewm.Cmd = "saacc"

oewm.FileOut = "c:\test\cm\report\t-34.txt"

sColstring = "[audited]"

sColstring = sColstring & ",[stratum]"

sColstring = sColstring & ",[selected]"

oewm.Colstring = sColstring

oewm.LocalCol = "stratum"

oewm.Table = "Attrib$"

oewm.Parm2 = ".95"

oewm.RunCmd

If oewm.ErrNo = 0 Then
    Application.StatusBar = "OK: " & oewm.FileOut
    'MsgBox oEWM.Sql
Else
    sMsg = "Errno: " & oewm.ErrNo & vbCrLf
    sMsg = sMsg & "Errtext: " & oewm.ErrDescription & vbCrLf
    MsgBox sMsg
```
Random Sequential Sampling

6.3 Output Report

The following text report is output by Audit Commander to summarize the results of the attribute sampling. (text report has been imported into Excel for ease of viewing).

<table>
<thead>
<tr>
<th>Strata</th>
<th>N</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Point Estimate</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>594</td>
<td>17</td>
<td>17.65%</td>
<td>0.91%</td>
<td>105</td>
<td>94</td>
<td>115</td>
</tr>
<tr>
<td>2</td>
<td>583</td>
<td>17</td>
<td>5.88%</td>
<td>0.35%</td>
<td>34</td>
<td>30</td>
<td>38</td>
</tr>
<tr>
<td>3</td>
<td>1132</td>
<td>12</td>
<td>8.33%</td>
<td>0.69%</td>
<td>94</td>
<td>79</td>
<td>110</td>
</tr>
<tr>
<td>4</td>
<td>863</td>
<td>12</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1399</td>
<td>12</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1142</td>
<td>12</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All</td>
<td>5713</td>
<td>82</td>
<td>2.86%</td>
<td>0.27%</td>
<td>164</td>
<td>134</td>
<td>194</td>
</tr>
</tbody>
</table>
Random Sequential Sampling

Comment form

Please send any comments, suggestions or items identified as errors to:

Mike.Blakley@ezrstats.com

Although I am not able to respond to all such comments and suggestions, I will try to do so as feasible. Registered users of Audit Commander will be notified as revised versions of the manual are released.