APPENDIX B

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APPENDIX B

B-000 Statistical Sampling Techniques

B-001 Scope of Appendix

This appendix presents essential principles and methods of statistical (probability) sampling applicable to contract auditing. In statistical sampling, each sample item in the universe has a determinable probability of being selected thus providing a basis for estimating the reliability of results. This appendix provides guidance for auditors in the design of a sampling plan and the selection and use of appropriate sampling methods for achieving audit objectives. The guidance applies to both estimation and acceptance sampling. It is not, however, a detailed course in statistical sampling. General audit sampling guidance, including the Agency's sampling policy, is discussed in 4-600, Audit Sampling.

B-100 Section 1 --- Impact of Other Sources of Reliance on Amount of Statistical Sampling

B-101 Introduction

This section discusses the interrelationship and interdependence of statistical sampling and the other contract audit techniques that serve as sources of reliance for audit conclusions and recommendations. In the examination of contract costs, the auditor's objective is to report an informed opinion on the propriety of the contractor's cost representations. In expressing an opinion, the auditor does not require certainty (which may not be practical to obtain) regarding the contractor's representations. The auditor only needs reasonable assurance that the audit conclusions are substantially correct. An understanding of these relationships is essential to the effective application of statistical sampling to contract auditing.

B-102 The Contract Auditor's Sources of Reliance

a. The fact that the audit report expresses an opinion and not a statement of absolute fact is of primary importance to the selection and application of appropriate audit procedures and techniques. The contract auditor may use any analytical or summary methods that will yield a sufficiently accurate determination or opinion. In forming this opinion the auditor is often able to rely on a number of sources of information. It is important to understand these sources in order to weigh properly their influence on the sampling plan. The contract auditor's principal sources of reliance include the following:

(1) Review and Analysis of Procedures and Controls. Procedures which are well designed, effectively operating, and combined with strong controls produce consistent results on which the auditor can rely with a minimum of testing. Conversely, weak or poor operating procedures or controls frequently produce inconsistent results or consistently wrong results. The latter conditions will require a more thorough examination. The auditor can gain knowledge of the contractor's system from formal or informal survey procedures.

(2) Comparison with Historical Cost Patterns. Techniques for evaluating the consistency of current costs with previous experience include the traditional auditing tools of comparative, ratio, and trend analysis, as well as graphic and regression analysis.

(3) The Test Audit or Test-Check Procedure. This audit procedure may be used to highlight undesirable practices or conditions; or it may be used to secure a cross-section of an audit area so that the auditor may draw conclusions about the entire area by examining

the sample. It is in the application of the test audit or test-check procedure that statistical sampling is most useful to the contract auditor.

b. By considering all of the sources of reliance available, the auditor is able to make an informed decision as to the level of substantive tests of detail that is required to be completed for a given audit circumstance. If all sources of reliance indicate favorable conditions, the auditor should limit substantive tests of detail to the minimum number that will support an informed opinion assuming a reasonable degree of risk. For example, when a survey indicates that the controls are strong and operating effectively and an adequate sampling of the records discloses no exceptions, the auditor has greater confidence in the reliability of the records than he/she would have from the sample alone. Correspondingly, the amount of sampling required to confirm other system or data analyses is less than when dependence is placed solely on the results of the sample.

c. Although the extent of the auditor's examination of records can be minimized by other sources of reliance, it cannot be eliminated when substantial dollar values or sensitive issues are involved. In all audits, a certain amount of record examination is required to ascertain that controls are actually effective and that procedures and practices, which were satisfactory in the past, have not changed. Furthermore, the auditor must consider the objectives as well as the effectiveness of internal controls. For example, controls designed to assure that costs are properly recorded from purchase orders and vouchers to appropriate accounts would influence a sample selection that is designed to determine if those costs were assigned to appropriate contracts.

B-200 Section 2 --- Design of the Nonstatistical or Statistical Sampling Plan

B-201 Introduction

This section discusses the design of the sampling plan and the elements that should be documented in the plan. Detailed sampling plans are developed for the sampling categories of:

(1) sampling for attributes and

(2) sampling for variables.

Sampling plan elements, common to both attribute and variable sampling, are discussed in B-300. Elements specific to sampling for attributes or variables are discussed in B-400 or B-500, respectively.

B-202 Statistical Sampling Methods

a. Auditors do not usually perform a 100 percent review of universe data. Therefore, auditors will normally use either statistical or nonstatistical sampling in their audits. The method selected depends on which is the most effective means of gathering sufficient appropriate audit evidence to satisfy the audit objective and support favorable resolution of any reported findings or conditions.

b. Statistical sampling uses the laws of probability for selection and evaluating a sample from a population for the purpose of reaching a conclusion about the population. A valid statistical sample requires that each sampling unit has a known chance of selection within a stratum, all sampling units must be randomly selected, and sample results must be evaluated statistically. Statistical sampling is preferred because of its advantages, which include objectivity, overall defensibility, and measurability of the risk of substantial (or material) sampling error.

c. A nonstatistical sample does not statistically evaluate the sample results to develop an unbiased projection or to measure sampling risk. Nonstatistical samples are rarely used in DCAA. A nonstatistical sample may be selected using a statistically valid selection technique, or it may be selected using another approach approximating the selection process for a statistical sample (e.g., haphazard sample selection method – see B-702a). Sample items should be selected so the sample can be expected to be representative of the population; therefore, all items in the population should have an opportunity to be selected. Nonstatistical sample results may not be projected to the sampling universe for questioned rates or dollars.

B-203 Sampling Plan Design and Documentation

a. The successful audit application of statistical sampling begins with the design of the sampling plan. Sampling plans are required for audit applications of both attribute sampling and variable sampling.

b. The general sampling plan elements are listed below. Detailed sampling plans for attributes and variables are discussed in B-204 and B-205, respectively.

(1) Briefly state the objective of the sample, specifying what the auditor is looking for in the universe.

(2) Describe the audit universe and state its size and value.

(3) Describe the sampling universe (after refining the population such as elimination of high dollar and/or low dollar values, removing items not likely to include errors based on the audit objective, credits and matching debits such as accounting adjustments for accruals/reversals) and other items from the sampling universe that are deliberately set aside for full review and state its size (see B-304). That is:

(a) describe the sampling unit (i.e., the basic auditable item to be examined),

(b) specify the scope of the audit so that all sampling units pertinent to the sampling objective can be identified and

(c) state the size of the sampling universe (i.e., the total number and amount of all sampling units.)

(4) Describe the sampling frame, that is, the physical or electronic representation of the universe to which the mechanics of sampling will be applied.

(5) Determine if the universe reconciles with the sampling frame. The sampling frame may include items not intended to be in the audit universe and it may exclude part of the universe. The auditor must develop remedies as required by the type of mismatch and as permitted by available information.

(6) Select a suitable sampling approach. For a variable sampling application, the auditor can choose physical unit sampling or dollar unit sampling (DUS). In sampling for attributes, the alternatives are acceptance or estimation sampling.

(7) Develop the sampling reliability parameters. The reliability parameters, to be specified for either attribute sampling or variable sampling, are listed in B-404.1 and B-505, respectively.

(8) When sampling for variables, establish a sample size using sample size table in B-505 or sample sizing utilities in EZ-Quant. In sampling for attributes, determine a sample size for each attribute using EZ-Quant.

(9) Describe the sample selection method.

(10) Identify the specific software to be used for the sample evaluation.

c. To maintain audit consistency, auditors should use the sampling plan formats described in B-204 and B-205 for all audit applications of statistical sampling. Audit working papers should include a complete sampling plan clearly referenced to where the sample selection and evaluation are located.

B-204 Detailed Sampling Plan for Attributes

Detailed elements (with examples) for an attribute sampling plan are:

a. State the objective for the sample.

(1) Briefly state the general objective. Attribute sampling deals with the frequency, not the dollar impact, of a specified type of error (or other characteristic of audit concern) in the universe. Concerning that error type or characteristic, the objective is either to:

(a) accept or reject the universe, or

(b) to estimate its frequency in the universe.

Examples of attribute acceptance sampling objectives include:

(c) determining whether compliance with timekeeping controls is adequate, and

(d) determining whether the accuracy of an inventory accounting system is acceptable.

An example of an attribute estimation sampling objective is to estimate the percent of invoices that were paid within 30 days of receipt.

(2) Identify the critical (significant) system features (attributes) to be tested. Some attribute examples are "Did the employee sign their time sheet (or card)?" or "Does the actual part count agree with the inventory system count?"

(3) Define the error condition for each attribute. For example, the inventory system is in error if the actual count differs from the inventory count by more than 5 percent.

b. Describe the universe.

(1) Identify the sampling unit. Some examples are an employee (for the time-keeping test) or a part number (for the inventory system test).

(2) Specify the audit scope to include all sampling units pertinent to the sampling objective. For example, the scope may include all first-shift, hourly employees for Departments A, B, and C (for a time-keeping test).

(3) State the universe size - the number of all sampling units. An example is the 2,000 first-shift, hourly employees for Departments A, B, and C.

c. Describe the sampling frame - the physical or electronic representation of the universe. An example is a computer listing of employee numbers for all hourly employees for all departments.

d. Determine if the universe reconciles with the sampling frame.

(1) Determine if the sampling frame includes units not intended to be in the universe. For example, a listing of employee numbers includes those for employees outside Departments A, B, and C.

(2) Determine if the sampling frame excludes part of the universe. For example, a listing of part numbers may exclude items stored in remote locations.

(3) Develop remedies as required by the type of mismatch and as permitted by available information.

e. Select a suitable sampling approach. An example for the inventory accounting system test is to use acceptance sampling if incorrect rejection (of an acceptable system) would call for a costly remedy; otherwise, use discovery acceptance sampling.

f. Develop desired values of sampling reliability parameters. Reference B-404 for guidance in establishing sampling reliability parameters.

(1) For acceptance sampling, the reliability parameters (B-404.1) are:

Critical Error Rate - the maximum error rate in the universe that is considered acceptable,

Desired Government's Risk - the tolerable level of risk of accepting a faulty universe (i.e., universe error rate is greater than the specified critical error rate),

False Alarm Error Rate - an acceptable universe error rate (less than critical error rate) used to control the risk of incorrect rejection (false alarm) of an acceptable universe, and

False Alarm Risk - the tolerable level of risk of rejecting an acceptable universe (i.e., universe error rate is less than the false alarm error rate).

(2) For estimation sampling, the sampling reliability parameters (B-404.2) are:

Precision Range - the width of the desired confidence interval for the universe error rate, and

Confidence Level - the likelihood (or probability) that the universe error rate, being estimated by the sample, will be within a specified range about the (point) estimate itself.

g. Determine a sample size for each attribute. Give the name of the specific software and inputs used to determine the sample size. For example: "The EZ-Quant discovery sample size estimation option will be used to determine the sample size for a discovery sample."

h. Describe the sample selection method. That is, briefly describe the way sample items are randomly selected.

i. Identify, by name, the specific software to be used for sample evaluation. For example: "The EZ-Quant discovery/one-step evaluation option will be used to evaluate the attribute discovery (acceptance) sample."

B-205 Detailed Sampling Plan for Variables

Detailed elements (with examples) for a variable sampling plan are:

a. State the objective for the sample.

(1) Briefly state the general objective. For example, the objective is to estimate the misstatement of proposed material costs.

(2) State the specific characteristics (potential sources of error) to be tested. Examples of potential sources of error are the differences between proposed prices and vendor quotes or between proposed prices and purchase history.

b. Describe both the audit universe and the sampling universe.

(1) Describe the audit universe to include the quantity and value of universe prior to segregating/refining the population such as elimination of High dollar and/or Low dollar values, removing items not likely to include errors based on the audit objective, credits and matching debits such as accounting adjustments for accruals/reversals, or other items to be examined separately from the sampled items.

(2) Identify the sampling unit. Some examples of sampling units are a line item on a bill of materials or a transaction in an overhead account.

(3) Specify the scope to include all sampling units pertinent to the sampling objective. For example, all travel accounts 100 and 101 for FY 20XX for Departments A, B, and C.

(4) State the universe size - the number and value (if applicable) of all sampling units. An example is the universe of 1,250 transactions, totaling $10,000,000, charged to the travel account during FY 20XX.

c. Describe the sampling frame - the physical or electronic representation of the universe. Some examples of sampling frames are a computerized consolidated bill of material report for some specific product, a data file (specifically named) of journal voucher entries for a specified period, or a file drawer of vouchers for a particular period.

d. Determine if the universe reconciles with the sampling frame.

(1) Determine if the sampling frame includes units not intended to be in the universe. An example would be a listing of travel vouchers that includes certain departments outside the scope of the audit.

(2) Determine if the sampling frame excludes part of the universe. For example, the same listing of travel vouchers excludes those units intended to be in the universe, such as travel vouchers recently incurred by off-site personnel.

(3) Develop remedies as required by the type of mismatch and as permitted by available information.

e. Select a suitable sampling approach. For example, physical unit sampling should be used when the primary audit risk is understatement of the sampling item's amount. Dollar unit sampling should be used when the sample includes items that are actually clusters of sampling units (such as multiple-invoice vouchers or BOM line items consisting of several part numbers).

f. Document the sampling reliability parameters. For variable sampling, the reliability parameters (B-504) are:

Confidence Level - the likelihood (or probability) that the universe amount, being estimated by the sample, will fall within a specified range about the point estimate itself. All statistical sampling applications will initially be based on a 90 percent confidence level for sample size determination and sample evaluation.

Precision Amount - the amount of sampling error, stated as a dollar amount that is considered acceptable by the auditor. The sample's actual achieved precision will be evaluated in the sample evaluation phase.

g. Establish the sample size consistent with the audit risk and objective (B-505).

h. Describe the sample selection method.

(1) If automated, give the name of the sampling software procedure. For example: "The EZ-Quant physical unit sample selection option will be used to select a physical unit sample" or, "The EZ-Quant dollar unit sample selection option will be used to select a dollar unit sample."

(2) If manual, briefly describe the universe stratification process (if done) and the way sample items are randomly selected.

i. Identify, by name, the specific software to be used for sample evaluation. For example: "The EZ-Quant physical unit sample evaluation option will be used to evaluate the physical unit sample" or, "The EZ-Quant dollar unit sample evaluation option will be used to evaluate the dollar unit sample."

B-300 Section 3 --- Statistical Sampling Plan Elements Common To Attribute and Variable Sampling

B-301 Introduction

This section provides guidance on sampling plan elements that are common to both attribute and variable sampling.

B-302 Identifying the Sampling Objective

a. A prerequisite to the application of any sampling process is the need to identify the specific audit objectives to be attained by examination of the area under evaluation. Prior to initiation of the sampling process, the auditor should definitively set forth in the sampling plan the characteristics and values to be examined during the audit. The auditor's sampling objective should satisfy the audit objectives in the area being audited.

b. The purpose of sampling is to infer something about a "characteristic" of the universe items under consideration. One typical universe characteristic is the total audited dollar amount. To permit inferences about this universe characteristic, it must be possible to determine an audited amount for each sample item examined by the auditor.

c. In the examination of sample items, the auditor is usually concerned with determining the existence of "errors." These errors are not limited to oversights on the part of contractor personnel. They may reflect differences of opinion between the auditor and the contractor as to the proper distribution of a cost or the appropriate documentation of transactions. A generalized objective statement (e.g., "to see if any errors exist" or "to determine if anything is wrong") should be avoided. The precise type of errors, occurrences, or values being audited must be defined in order to design an economical or efficient sampling plan.

d. Frequently, the objectives of the audit may require the examination of all items for several characteristics. The sampling plan should take into consideration that findings from the sample of each characteristic should be kept separate for individual analysis and not combined, since each characteristic may be of different audit significance. For example, suppose a floor check of employees, selected by a random sample disclosed that:

(1) some employees who were late, or absent were being checked in by other employees and

(2) some job tickets, which were otherwise correct, were not being countersigned by the supervisor.

An analysis based on the combined number of errors would be less informative than separate analyses of the errors in each category.

e. When different categories of errors disclosed by a sample can be evaluated monetarily, the findings can be combined if they are recurring in nature and not peculiar to only certain characteristics or accounts. For example, suppose a sample of travel vouchers disclosed unallowable costs for:

(1) entertainment of customers and

(2) the excess cost of first-class over other available air accommodations.

Separate estimates of the amount of unallowable expenses in each category would not be necessary since the auditor's objective is to obtain a reliable estimate of the total amount of unallowable expenses.

f. If monetary errors are evidently peculiar to certain characteristics or subareas, or are apparently nonrecurring, they should not be combined. A judgment is required as to whether or not a particular type of unallowable cost should be projected across-the-board. There is occasionally an advantage to separate treatment, such as a reduction in an unreasonable confidence interval (or precision, as discussed in B-504). Suppose, for example, relocation costs were included in travel expense and no costs were questioned in this category, the confidence interval could be narrowed by stratifying out relocation costs.

g. When the auditor has reason to believe that a cost category includes a significant amount of unallowable expenses, the purpose in taking a sample will generally be to estimate the total amount of unallowable expenses. On the other hand, if the auditor has no reason to believe the costs being audited include unallowable amounts, the purpose will generally be to obtain additional assurance that the costs do not, in fact, include a significant amount of unallowable expenses. In either case, the auditor should seek to develop a sampling plan that will provide maximum support for conclusions in return for the time spent in the selection, examination, and evaluation of the sample. In addition, the sample size should provide a reasonable balance between:

(1) the amount of support the sample will provide for audit conclusions and

(2) the expenditure of auditor resources the sample will require.

B-303 Sampling for Attributes or Variables

a. The sampling of characteristics may be divided into two broad categories of sampling for attributes and sampling for variables. When sampling to determine the rate or proportion of errors in the records or to obtain assurance that an error rate is not excessive, the auditor is sampling for attributes. Sampling for variables is performed when a sample is selected in order to estimate an amount, such as the dollar value of unallowable costs contained in the total dollar value of material invoices charged to a Government contract. The distinction is important because the methods used to evaluate sample results differ.

b. The same sample may be used for attributes and variables. For example, in evaluating direct material costs, the auditor may want to estimate both the percentage of purchases made without competition and the dollar amounts improperly charged to a Government contract.

B-304 Describing the Universe

a. A universe is a group of items or transactions from which information is desired. Some statistical texts refer to the universe as the group of items before segregation and audit stratification of items for detailed examination. However, in this appendix the term “universe” will refer to the “sampling universe”, the group of items which remains after the large dollar, or sensitive transactions, have been stratified (or segregated) for complete (as opposed to partial) audit examination.

b. The sampling unit is the basic unit that will be examined. A sampling unit may be a document or record, such as a purchase order or travel voucher, or may be an item reflected on the document or record. As an example, an objective may be to determine how many, if any, purchase orders lack adequate supporting documentation; or the objective may be to verify certain characteristics of the items on the purchase orders, such as whether each item's cost is correct. If the examinations were to be made on a sampling basis, the sampling unit in the first instance would be a purchase order. In the second instance, the sampling unit would be a line item on a purchase order. If there were several line items on each of the purchase orders, it can be readily seen that the sizes of the two groups would differ substantially.

c. With dollar unit sampling (DUS), it is often implied that “dollar units” or “dollar hits” as opposed to physical units are being sampled. Physical units are the sampling unit, with sample items being identified by the dollar hits. In order to evaluate a dollar hit the item (e.g., the cost of a physical unit) containing the dollar hit must be analyzed. In the event that DUS selects units that are clusters (e.g., subassemblies) which can be broken down into smaller auditable units (e.g., subassembly parts), the smaller units containing the hits can become the sampling units. If this is done for one cluster, it must be done for all clusters in the sample.

d. The universe is the aggregate of all sampling units. Therefore, the auditor must specify the scope of the sample to ensure that all sampling units pertinent to the sampling objective will be included in the universe. Examples of criteria that specify scope include accounts, time period, dollar range, bill of material, and organizational units.

B-305 Describing the Sampling Frame

a. The sampling frame is the physical (or electronic) representation of the sampling units from which the sample is actually selected. In sampling for attributes, an example of a sampling frame could be a computer listing of employee numbers for all hourly employees for all departments. The sampling unit would be the employee, each represented by an employee number on the listing. In sampling for variables, examples of sampling frames include a computer listing of a consolidated bill of material, a data file of journal voucher entries, and a file drawer of vouchers. For these sampling frames, possible sampling units are a part number, item number, or physical voucher.

b. One sampling frame requirement is that it be a complete representation of all sampling units constituting the universe. Since auditor conclusions derived from a sample pertain to those sampling units actually represented in the sampling frame, the auditor must determine if the sampling frame excludes part of the previously defined universe. It may be necessary to make the sampling universe smaller by redefining it to exclude items not included in the sampling frame. In any case, the auditor should reconcile the universe with the sampling frame and document any required adjustments in the audit working papers.

c. When the sampling frame contains items not intended to be in the universe (for example, if a listing of travel vouchers included vouchers from departments outside the scope of the audit), there are two ways to proceed depending on whether the number and amount of out-of-scope items are known. The auditor may either (i) exclude out-of-scope totals from the universe totals and replace out-of-scope items in the sample (if the totals are known), or (ii) leave out-of-scope items in the sample but question no costs in them (if the totals are unknown). However, if questioned costs are found in the out-of-scope items, these items must be addressed separately to ensure adequate audit coverage. Either remedy should be documented.

B-400 Section 4 --- Statistical Sampling for Attributes

B-401 Introduction

This section provides detailed guidance for developing sampling plans that are specifically related to sampling for attributes.

B-402 Use of Sampling for Attributes

a. Attribute sampling can be classified into two approaches of acceptance and estimation sampling. Their use depends on audit objectives. With acceptance sampling, the goal is to either accept or reject the universe. With estimation sampling, the goal is to estimate the actual error rate in the universe.

b. Attribute sampling is performed when there are only two possible outcomes from the evaluation of a sample item: the sampled item either is or is not in compliance with the control being tested. An audit can be built around questions answerable by either "yes" or "no", a feature that distinguishes sampling for attributes from sampling for variables.

B-402.1 Attribute Acceptance Sampling

Attribute acceptance sampling is typically used for evaluating a contractor's internal controls. This includes the evaluation of policies, procedures, and practices to determine the adequacy of internal controls or their operational effectiveness or efficiency. Since perfection is seldom expected, there is some level of noncompliance that can be tolerated. Attribute acceptance sampling is designed to discern whether noncompliance is within tolerable limits. In acceptance sampling, the minimum sample size can be determined and used to distinguish between tolerable and intolerable conditions. The tolerable level of noncompliance or critical error rate (defined in B-404.1b) is specified in advance. Acceptance sampling is not designed to estimate questioned costs. Instead, poor compliance revealed by an acceptance sample would normally prompt recommendations for system changes.

B-402.2 Attribute Estimation Sampling

a. In contrast to acceptance sampling, estimation sampling is designed to estimate the noncompliance rate with a level of precision (confidence interval for the universe error rate) specified by the auditor. Of course, the results of an estimation sample could be used to reach an accept-or-reject decision. However, the sample results would have to be compared with the same tolerable level of noncompliance (critical error rate) that would be used in developing an acceptance sampling plan.

b. Attribute estimation sampling is generally applicable to audits where compliance of the universe is being estimated as opposed to being subject to a pass/fail test. Estimation sampling is appropriate when the audit objective is to estimate an adjustment (impact) to a statement of error conditions. In other cases, such as the sampling of individuals in work sampling, it can be used to estimate the error (or idleness) rate.

B-403 Selecting the Sampling Approach

B-403.1 Acceptance Sampling Approach

For acceptance sampling, three sampling procedures are available for compliance testing:

(1) discovery sampling,
(2) one-step acceptance sampling, and

(3) two-step acceptance sampling.

Acceptance sampling procedures are designed to test whether the rate of a particular type of error exceeds a specified acceptable or tolerable level. The procedures are pass/fail tests that place limits on the risks that the results will be misleading. An acceptance sampling plan consists of a sample size and acceptance number of errors. If the number of errors found in the sample exceeds the acceptance number, the universe is deemed unacceptable

a. Discovery sampling is a special case of one-step attribute acceptance sampling. In attribute discovery sampling, the acceptance number of errors is zero. This feature provides a minimum sample size, achieved by considering only the risk of accepting a faulty universe (i.e., universe error rate greater than –a specified critical error rate, as defined in B-404.1b).

b. A one-step acceptance sampling procedure determines both the sample size and an acceptance number of errors using a single sampling step.

(1) In addition to considering the risk of accepting a faulty universe, one-step acceptance sampling considers the risk of rejecting an acceptable universe (i.e., a universe with an error rate less than a specified false alarm error rate, defined in B-404.1c). If the risk of wrongful rejection of an acceptable universe is not an audit concern, discovery sampling (with its minimum sample size) is the preferred sampling option.

(2) This sampling procedure or the related two-step procedure should be used when the auditor needs to control the risk of rejecting an acceptable universe, such as when remedial measures prompted by rejection are unusually costly. The one-step procedure is preferable to the two-step procedure when there is reason to believe that the actual error rate falls in the interval between two specified error rates (i.e., critical error rate and false alarm error rate).

c. The two-step acceptance procedure is similar to its one-step counterpart except that it breaks the sample into two individual steps, making it possible that the second step will be unnecessary, but giving the universe a second chance for a favorable finding. The first step is essentially an attribute discovery step since its acceptance number of errors is set to zero. This sampling procedure should be used when:

(1) There is reason to believe that the actual error rate is minimal (less than the specified false alarm rate) and no errors are likely to occur in the sample. With no first-step errors, the auditor would accept the universe at that point and would not perform the second step.

(2) There is reason to believe that the actual error rate is substantial (greater than critical rate) and numerous errors are likely to occur in the sample. If errors found in the first step exceed the combined acceptance number for both steps, the auditor would reject the universe at that point and would not perform the second step. However, the auditor should assess whether the second step should be completed based upon an analysis of the findings and their sensitivity as discussed in B-407.1a. It may be beneficial to complete the second step if greater accuracy is required for the point estimate (i.e., error rate).

B-403.2 Estimation Sampling Approach

An attribute estimation sample is designed to estimate the frequency of a specific type of error in a universe. A sample size is determined that provides a desired level of assurance (or confidence) that the error rate is estimated with a desired degree of precision (i.e., distance between the confidence limits).

B-404 Developing Sampling Reliability Parameters – Attributes

B-404.1 Acceptance-Sampling Reliability Parameters

a. In acceptance sampling, attributes should be evaluated individually so that an auditor can make a pass/fail decision relative to each tested feature of the system or universe being audited. The auditor should prioritize the attributes because some attributes are normally more critical than others.

b. All three acceptance sampling procedures described in B-403.1 consider the risk of accepting a faulty universe. A universe is faulty when its actual error rate is greater than a maximum acceptable error rate (critical error rate, discussed below) specified by the auditor. Also, the level of assurance (or its corresponding acceptable level of risk, discussed below) must be specified in acceptance/discovery sampling.

(1) The critical error rate (CER) is the maximum error rate in the universe that is considered "acceptable" by the auditor. For example, there may be only one error in 5,000 transactions, indicating an error rate of only 0.02 percent, but the specific type of error may indicate serious problems (such as fraud). On the other hand, a higher rate could reflect errors of less significance which are of a random nature and show no trend or pattern. Accordingly, the significance of an error rate must be evaluated in terms of its potential effect on Government contract costs. For example, a one percent error rate in direct labor or material costs charged to Government contracts by a large contractor could result in overcharges totaling hundreds of thousands of dollars over the course of a year. A five percent error rate in a $100,000 overhead account which is allocated in large part to commercial work would be less significant. As with all reliability goals, the value assigned to the critical error rate will affect the required sample size.

(2) The desired assurance, or confidence level (CL), is the reliability (in this case, the likelihood of reaching the right conclusion) that an auditor wishes to place on the sample results. Since it is often easier to think in terms of risk, the complement of the confidence level (100 - CL, when both are stated as a percentage) can also be used in acceptance sampling. This risk term is defined as the “Government's Risk” (GR) in the EZ-Quant software. All attribute sample planning will use a 90 percent confidence level (or a 10 percent Government Risk factor) to establish sample sizes.

c. Unlike discovery acceptance sampling, both one-step and two-step acceptance sampling procedures consider the risk of rejecting an acceptable universe. In Discovery Sampling, there is the possibility of rejecting an acceptable universe, this is sometimes referred to as a “false alarm”. An acceptable universe is one with an actual universe error rate that is less than a minimum rate, the “false alarm error rate”, specified by the auditor. A corresponding criterion, “false alarm risk,” must also be specified in one-step or two-step acceptance sampling.

(1) The false alarm error rate (FAER) is a user-specified acceptable universe error rate used to control the risk of false alarm. A universe with an error rate less than the FAER is clearly acceptable, and in some audit situations it is prudent to limit the likelihood that the sample will prompt its rejection. The FAER must be less than the CER.

(2) The false alarm risk (FAR) is the tolerable level of risk of rejecting an acceptable universe, the latter being defined by the FAER.

(3) The FAER and the CER define a range of error rates that are cautiously acceptable. It makes sense to set the CER high enough so that, at best, it is only marginally acceptable, meaning that a slightly lower rate would be acceptable but would prompt substantial caution and a slightly higher rate would be unquestionably unacceptable. Similarly, it makes sense to set the FAER low enough so that a slightly higher rate would prompt caution but a slightly lower rate would be unquestionably acceptable. An error rate in between would be acceptable but would still prompt varying levels of caution. This is summarized below:

Set the critical error rate and false alarm error rate so that . . .	
If the actual error rate were . . .	Then the universe is . . .
Above the critical error rate	Clearly unacceptable.
Between the false alarm error rate and the critical error rate	Cautiously acceptable, ranging from marginally to clearly acceptable.
Below the false alarm error rate	Clearly acceptable.

B-404.2 Estimation-Sampling Reliability Parameters

For attribute estimation sampling, the sampling reliability parameters are the desired precision range, the desired confidence level, and the anticipated error rate. Specification of the values for these parameters for the attribute estimation sampling procedure described in B-403.2 are discussed below.

a. The anticipated error rate is a judgmental assessment of the actual universe error conditions and is used to determine a sample size that meets precision and confidence criteria. It is not the anticipated sample error rate. Normally, the auditor will refer to past experience with the same or similar systems (or universes) to specify the anticipated error rate. It is useful to specify a conservatively high (yet still reasonable) anticipated error rate because the slightly higher sample sizes thereby derived will provide somewhat better sampling precision.

b. The precision range is the desired width of the confidence interval that will be computed from sample results.

c. The confidence level is the desired assurance that the actual error rate will be within the upper and lower confidence limits that will be determined from the sample results. All attribute sample planning will use a 90 percent confidence level to establish a sample size.

B-405 Determining Sample Sizes

a. Although sample sizes can be determined manually from published sampling tables, auditors should use the EZ-Quant software to compute sample sizes for acceptance and estimation sampling procedures.

b. The auditor should rank the attributes according to their relative importance. Normally, the most critical attribute will require the largest sample. For each attribute, the required sample size should be determined using the appropriate EZ-Quant acceptance or estimation sampling size option. The maximum number of items to be selected will be the largest of all the sample sizes, determined based on the sample sizes for the individual attributes.

B-406 Describing the Sample Selection Method

Proper implementation of the auditor's sampling plan requires that:

(1) the required number of items be drawn randomly from the universe and

(2) each item be evaluated for compliance.

In a randomly selected sample, each item has a known chance (or probability) of being selected. The results of a randomly selected sample can be objectively applied to the universe (or system) to assist the auditor in deciding whether the universe is in compliance with the system control being tested. Section B-700 discusses the various random selection methods.

B-407 Identifying the Attribute Sample Evaluation Method/Software

In sampling for attributes, aside from the pass/fail conclusion of an acceptance sample, the results of the examination are expressed as an estimate of the actual error rate. The estimated error rate is the ratio of the error occurrences to the sample size. For each attribute, sample findings should be tabulated separately as if each constituted an independent and separate sample. This is necessary to isolate critical problem areas for further audit effort and to possibly terminate testing in other areas.

B-407.1 Acceptance-Sample Evaluation Method/Software

a. In acceptance sampling, the pass/fail purpose of the sample is accomplished when the acceptance number of errors is exceeded or when the sample is completed, whichever comes first. However, the auditor may want to proceed beyond a pass/fail conclusion in the event of a failure. The auditor should assess whether the second step should be completed based upon an analysis of the findings and their sensitivity. It may be beneficial to complete the second step if greater accuracy is required for the point estimate (i.e., error rate). For example, in a timekeeping audit, the number of errors in the first step may exceed the combined acceptance number. The auditor may conclude the system error prevents system reliance, and refining the error rate at this point serves no useful purpose. Therefore, the second step is not performed. In a second example, the auditor may test whether contractor employees on a specific contract meet education or skill requirements. The auditor desires a very accurate error rate to include in the condition statement. As such, the auditor may decide to complete the second step even if the combined acceptance number is exceeded after the first step. In this instance, the sample also takes on the role of an estimation sample in addition to a pass/fail or acceptance sample.

b. For proper evaluation of the confidence interval, the auditor must complete the sample even if the acceptable number of errors is exceeded. When using EZ-Quant, the auditor's selection of the appropriate sample evaluation procedure depends on which attribute sampling procedure was previously selected (i.e., discovery, one-step or two-step acceptance).

c. The one-step acceptance sample evaluation option of EZ-Quant should be used to evaluate sample results from either discovery or one-step acceptance sampling procedures. The one-step sample evaluation procedure permits the auditor to focus on a pass/fail decision derived from an acceptance sample. It duplicates what is apparent from comparing the number of errors in the sample to the acceptance number of errors specified in the sampling plan. Failure of the universe presents a more compelling reason to focus on the pass/fail decision. An analysis of the sampling error is possible by using sample evaluation options to:

(1) specify a confidence level and obtain an upper precision limit (to compare with the CER specified in sampling plan) or

(2) specify an upper precision limit and obtain a confidence level (to compare with the sampling plan specification).

d. The two-step acceptance sample evaluation option of EZ-Quant should be used to evaluate the results of a fully implemented two-step acceptance sample. This analysis is similar to the one-step sample evaluation described above.

B-407.2 Estimation-Sample Evaluation Method/Software

In estimation sampling, the sample results are evaluated to determine whether the desired levels of assurance and precision, as specified in the sampling plan, were achieved. The one-step acceptance sample evaluation option of EZ-Quant should be used to evaluate the results of an attribute estimation sample.

B-500 Section 5 --- Statistical Sampling for Variables

B-501 Introduction

This section provides detailed guidance for developing sampling plans that are specifically related to sampling for variables.

B-502 Use of Sampling for Variables

a. Variable sampling is generally used to verify account transactions or balances and to note any differences. This type of sampling is substantive testing (as opposed to compliance testing) whereby sample items are evaluated for error amounts or variables (as opposed to attributes). The audit sampling universe (e.g., accounts, vouchers, or bill of material) is the entire grouping of items from which a sample will be drawn. Variable sampling can be widely applied in contract auditing, for example to proposals, incurred costs, progress payments, forward pricing rates, and defective pricing.

b. An important objective of variable sampling is to estimate a particular universe characteristic such as total unallowable costs (or questioned cost). The estimated questioned cost is commonly known as the “point estimate.” A point estimate strikes a balance between potential understatement (considering both likelihood and amount) and potential overstatement of the true universe amount. In statistical sampling, “confidence level” and “precision” are used to measure the reliability of the point estimate. The confidence level deals with “sureness” (or assurance) while precision deals with “closeness” (or accuracy). These two measures, taken together, describe the achieved sample results.

B-503 Selecting the Sampling Approach

In the application of variable sampling, the auditor can choose either physical unit sampling or dollar unit sampling (DUS). The important difference between these sampling approaches is the way sample items are selected and thus the chance each item has of being selected. In either case, the unit to be selected and examined will be a “physical unit”, typically a document or record (such as a purchase order, travel voucher, or individual bill of material item) or perhaps, in the case of DUS, an auditable line item within the document or record. With physical unit sampling, each physical item within a stratum has an equal chance of selection. With DUS, an item’s chance of selection is directly proportional to its size (expressed in dollars).

B-503.1 Physical Unit Sampling

a. Most audit universes are widely dispersed. Usually, there is a wide variation between the smallest and largest individual dollar amounts, with most of the amounts being relatively small and only a few amounts being very large. Since a random sample from the entire universe would probably include only a few large (high dollar) items, the reliability of the results would be correspondingly low. This is possible because wide variations are likely between questionable amounts for individual large items and the average of questionable amounts from the universe.

b. Stratification of the universe into several dollar ranges or strata can be used to improve audit reliability and reduce the overall number of items evaluated. Normally, the universe is stratified into a high-dollar stratum (for 100 percent evaluation) and several other strata from which samples are selected for evaluation. Audit effort is concentrated on the high-dollar items where the risk is greater. Samples are statistically selected from each of the other strata, which are used as the basis for projecting individual stratum sample results to the corresponding universe.

c. In physical unit sampling, sample items can be randomly selected either manually or by using the EZ-Quant software package. The auditor then evaluates the sample items and determines any cost that should be questioned. Sample results can be projected to the universe and evaluated by the auditor using the physical unit sample evaluation option of EZ-Quant. EZ-Quant will determine both the point estimate (projection of sample results to universe) and the associated confidence interval.

B-503.2 Dollar Unit Sampling (DUS)

a. Dollar unit sampling is a substitute for stratification by dollar amount. DUS's selection probability proportional to size (PPS) feature concentrates the sampling evaluation toward larger dollar items much the same as stratification does for physical unit sampling. In general, the two approaches are roughly similar in what they can accomplish. DUS does have an advantage in dealing with selected items that prove to be clusters of smaller physical units.

b. Dollar interval selection is used to select DUS samples. An interval is determined, and items with an absolute value exceeding the interval are automatically selected for evaluation and removed from the universe. The remaining items comprise a single sampling stratum. A starting value less than the interval is initially randomly determined. The initial “start dollar” becomes the first “dollar hit”. Subsequent hits are determined by adding the value of the sampling interval to the prior dollar hit until the process has stepped through the entire sampling stratum. The sample items to be evaluated are those containing each respective “hit dollar”.

c. In dollar unit sampling, sample items can be randomly selected by using appropriate DUS software such as the EZ-Quant dollar unit sample selection option. After evaluating the sample items associated with the dollar hits, the auditor determines any costs that should be questioned. As with physical unit sampling, the auditor can manually project DUS results to the universe. However, it is preferable to use DUS evaluation software (i.e., the EZ-Quant dollar unit sample evaluation option) to determine the point estimate (projection of sample results to universe) and the associated confidence interval.

B-504 Sampling Reliability Parameters – Variables

a. The statistical reliability of sample findings is measured by two interrelated parameters, precision and confidence level.

b. The term “precision” pertains to the amount or degree of probable error associated with an estimate (or the extent to which the sample findings may differ from the actual universe values or conditions). It measures the accuracy of a point estimate by showing, for a specified confidence level, how much the point estimate may vary from the true universe amount.

c. In sampling for variables, precision can be expressed as either:

(1) an interval about the point estimate obtained from the sample or

(2) a maximum or upper limit such as “less than $50” or “less than 6 percent error.”

In most cases, the primary consideration influencing the auditor's selection of a desired level of precision will be the potential effect of the error on Government contract costs.

d. In establishing the desired precision amount in terms of dollars, the auditor should estimate what dollar amount will be considered as tolerable or immaterial. It makes sense to equate the precision amount to a materiality threshold because the precision amount is a measure of how much the point estimate derived from the sample might understate or overstate the actual universe amount.

e. Confidence level is the assurance (or probability) that the amount being estimated by the sample will fall within a specified range (or interval) determined from sample results. A confidence interval is commonly (but not always) defined as the point estimate plus or minus the precision amount. In formal terms, a 90 percent confidence level, for example, indicates that with repeated sampling under the same sampling plan, 90 times out of 100 the actual universe amount is expected to be within the interval computed from the sample results. In practical terms, this means that any single sample has a 90 percent chance of producing an interval that includes the actual universe amount.

B-505 Establishing the Sample Size

B-505.1 Small Universes (250 Items or Less)

a. Auditors should carefully assess if a sample methodology is the best approach when dealing with a small universe. Auditors should consider whether a judgmental selection methodology, such as only testing high dollar items, would be more efficient when a small number of items represent a significant portion of the universe value.

b. Generally, when sampling universes of 50 to 250 items, at least 20 percent of the items should be selected for review; with a minimum statistical sample size of at least 30 items.

B-505.2 Larger Universes (250 Items or Greater)

a. When the sample universe is greater than 250 items the sample size will be determined using the table below; which incorporates a 90 percent confidence level. The table is based on acceptance sampling theory adapted to Dollar Unit Sampling, which is the Agency's preferred method of statistical sampling. The table can also be used for physical unit sampling; however, physical unit sampling generally requires the universe be stratified and larger sample sizes (perhaps 10 to 20 percent) may be necessary. These are minimum sample sizes. If the audit risk warrants, these subject sample sizes must be increased accordingly. This table will be used for both statistical and nonstatistical sampling applications.

Table E-5-1
Table of Minimum Sample Sizes

	Tolerable Misstatement		
Expected Error Rate or Expected Variability in Questioned Ratios	High	Moderate	Low
Low	47	58	77
Moderate	69	86	114
High	87	109	145

b. In addition to the confidence level, the table is based on two other considerations, which are: (1) the level of tolerable misstatement, and (2) the expected error rate or expected variability in cost questioned ratios. Both of these items impact sample size.

c. Tolerable misstatement is a planning concept and is related to the auditor's determination of materiality. Tolerable misstatement is the maximum error in the population (i.e., the account) that the auditor is willing to accept (tolerate) and still consider the universe to be acceptable as is. The auditor must select a rating of: low, moderate, or high. When planning a sample for a test of details, the auditor should consider the amount of monetary misstatement in the related account balance that may exist before the account balance is considered materially misstated. The total potential misstatement represents the sum of those misstatements found in the sample and as a result of other related tests. This maximum monetary misstatement the auditor is willing to accept for the balance or class of transactions is called the tolerable misstatement for the sample.

d. In determining a minimum sample size, using the column titled "Expected Error Rate or Expected Variability in Questioned Ratios" the auditor must also select a rating of: low, moderate, or high. This column represents the auditor's expectation that universe error conditions, in terms of costs questioned, are at a low, moderate, or high level. An assessment set at low results in a smaller sample size reflective of the auditor's expectation of few misstatements. An assessment set at high would reflect the auditor's expectations that a large number of errors exist in the account, for example contractor controls to identify unallowable costs are poorly designed or not operational. If you anticipate that the expected error rate (total cost questioned divided by universe amount) is substantial, then the assessment should be “high.”

e. If you expect significant variability in the individual sampled items’ cost questioned ratios (cost questioned/sample item’s value), then the assessment should also move towards “high.” For example, if you anticipate the cost questioned ratios will vary greatly (i.e., sample item 1- questioned 20 percent, sample item 11 – questioned 80 percent, sample item 25 – questioned 5 percent, etc.) from sample item to sample item then the assessment should move towards “high.” Larger sample sizes are necessary when the auditor anticipates significant variability in the sample items questioned ratios.

f. Auditors must consider both factors in determining the sample size. Each sampling application requires its own unique, tailored and documented assessment based on the performing auditor's judgment. Considering both tolerable misstatements and the expected error rate will assist the auditor in selecting a sample size appropriate for the audit; balancing materiality and audit risk.

g. If the auditor has no knowledge regarding the tolerable misstatement, expected error rate, or the expected variability in questioned ratios, the auditor should assess these items using the most conservative assessment possible (i.e., using the largest resulting sample size).

h. All rationale used in assessing the level of tolerable misstatement and the expected error rate or expected variability in questioned ratios should be adequately documented in the sampling plan. The risk criteria assessment used to determine the sample size must be consistent with conclusions reached in the audit’s risk assessment section of the working papers (i.e., working paper section B).

i. Should the auditor choose to use the Sample Sizer option in EZ-Quant, he/she will use a 90 percent confidence level to establish sample size and must use sample sizes no less than those shown in Table E-5-1. The EZ-Quant sample size estimation option allows the auditor to determine the optimum sample size for variables sampling based on three factors:

(1) presumed error rate or the results of a sample from a similar audit universe,
(2) precision amount, and
(3) confidence level.

It is best to invoke the sample sizing option after the audit universe has been read into EZ-Quant so that the precision-enhancing feature of a high dollar stratum, if there is to be one, can be accounted for in the prescribed sample size. The benefit of using the Sample Sizer is that the user can immediately see the impact on the calculated sample size of increasing or decreasing one or all of the reliability parameters. The auditor has a better chance of achieving the desired level of sampling reliability when the parameters are directly factored into sample size determination.

B-506 Describing the Sample Selection Method – Variables

Proper implementation of the auditor's sampling plan requires that:
(1) the required number of items be drawn randomly from the universe and
(2) each item be evaluated for acceptability of its recorded cost.

In a randomly selected sample, each item has a known chance (or probability) of being selected. A random sample can be selected either manually by the auditor or automatically using EZ-Quant. The results of a randomly selected sample once evaluated can be objectively applied to the universe from which it was drawn to compute the projected cost questioned.

B-506.1 Physical Unit-Sample Selection

a. When manually selecting a physical unit sample, the auditor should briefly describe the stratification process (if used) and the sample selection method. A detailed discussion of various random selection methods is included in B-700.

b. The physical unit stratified sample selection option of EZ-Quant can be used to stratify a universe and select a sample. This EZ-Quant option will divide the universe into strata, determine the number of sample items for each stratum, and randomly select the sample items for each stratum. The auditor must specify both the number of strata and the total number of items. After evaluating the sample items, the auditor will enter the questioned amounts into a data file so that the point estimate (for projection to the universe) and sampling precision can be determined by the physical unit sample evaluation option of EZ-Quant.

B-506.2 Dollar Unit-Sample Selection

a. When manually selecting a sample, the auditor should document the details of the sample selection method. A detailed discussion of the systematic selection method, normally used in DUS applications, is included in B-705.

b. The dollar unit sample selection procedure in EZ-Quant divides the universe into two strata (high dollar and sampling), determines the number of items to be evaluated from each stratum, and randomly selects the sample from the sampling stratum. Either a sampling interval or a sample size must be specified. If the sample size is specified, its corresponding implied interval is computed. The high-dollar stratum consists of items having absolute amounts that are equal to or greater than the interval amount. All other items make up the sampling stratum. The automated sampling process differs from the general description in B-503.2b in that EZ-Quant will randomize the universe prior to interval selection, thereby guaranteeing the independence among sample items that is necessary for proper sample evaluation. Also, the automated method involves an iterative process of determining the interval so that for a given desired sample size or a given number of total review items (high dollar and sample), the interval is adjusted as high dollar amounts are removed from the sampling stratum. After evaluating the sample items, the auditor will enter the questioned amounts into a data file so that the point estimate (for projection to the universe) and sampling precision can be determined by the dollar unit sample evaluation option of EZ-Quant.

B-507 Identifying the Variables Sample Evaluation Method/Software

In sampling for variables, the sample evaluation results are usually expressed in terms of a point estimate of unacceptable (or questioned) costs in the sampled universe. The auditor should evaluate sample reliability and accuracy (in terms of the precision at a given confidence level) so that the materiality of potential understatement or overstatement of questioned costs can be determined.

B-507.1 Physical Unit-Sample Projection Method/Software

a. The point estimate may be manually computed by the auditor using either the "ratio" or the "difference" method.

(1) The ratio method computes the ratio of unallowable costs in the sample to total costs examined in the sample and applies this ratio to the total costs in the universe. For example, an examination of a sample of 125 items with a recorded value of $160,000 from a universe of 1,200 items with a recorded value of $1,500,000 disclosed unallowable costs totaling $16,000. The calculated ratio would be 0.10 (i.e., $16,000 divided by $160,000). Also, the point estimate of total unallowable costs would be $150,000 (i.e., 0.10 times $1,500,000).

(2) The difference method is also known as the "mean" or "average" method. This method computes the average dollar amount of the errors in the sample and multiplies this average by the number of items in the universe. For example, if a random sample of 125 items from a universe of 1,200 disclosed unallowable costs totaling $16,000, the average would be $128 (i.e., $16,000 divided by 125 items). The point estimate of total unallowable costs would be $153,600 (i.e., $128 times 1,200 items). In the case of a stratified sample, the point estimates obtained for each stratum are simply added together to obtain the point estimate for the total unallowable costs.

(3) If the number of items in the universe is unknown, the ratio method should be used. (It will still be necessary to estimate this number in order to obtain a confidence interval, but the estimate will not affect the calculation of unallowable costs.) If the total dollar value of the items is unknown, the difference method should be used. (The total dollar value will not affect either the point estimate or related confidence interval under the difference method.) When both the total number and dollar value of the items in each stratum are known, it is not necessary for the auditor to choose between the two methods in advance. When the sample results are evaluated, the method that produces the smaller confidence interval (least amount of precision) at a given confidence level should be used.

(4) When the unallowable costs for individual items tend to be in proportion to the recorded costs, the ratio method will usually produce the smaller confidence interval. When this relationship is weak or insignificant, the difference or mean method will usually produce the smaller confidence interval.

b. The physical unit sample evaluation option of EZ-Quant projects sample results to the unevaluated portion of each stratum for the ratio and difference methods. Projections are performed for each method because one method is normally more precise than the other. After the auditor specifies a confidence level, the point estimate, precision, and confidence interval (for each stratum and overall) are determined. The auditor will use the overall point estimate which has the lowest precision amount, and, therefore, produces the smallest confidence interval.

B-507.2 Dollar Unit-Sample Projection Method/Software

a. When manually projecting questioned costs in DUS, the ratio of cost questioned to cost examined is determined for each item evaluated. These ratios are added together and divided by the number of sample units evaluated. The resulting average ratio is then multiplied by the universe dollar to yield the point estimate. Assume a sample of 47 items from a universe of $500,000 resulted in three items questioned, as shown below. Computation of the point estimate would be as follows:

	Examined	Questioned	Ratio
	$100	$30	.3
	50	50	1.0
	5	1	.2
Total of questioned ratios			1.5
Average of questioned ratios (1.5/47)			0.03
Total cost questioned ($500,000 X .03)			$15,000

In this example, we evaluated 47 items and derived an average of the questioned ratios of $.03 per dollar. This average ratio is applied to the total absolute universe amount.

b. The dollar unit sample evaluation option of EZ-Quant computes the point estimate, precision, and upper and lower confidence limits from the results of the dollar unit sample.

The point estimate is computed by multiplying the total dollars in the sampling stratum by the simple average of the each item's ratio of questioned amount to evaluated amount.

B-507.3 Sample Evaluation Method

a. The auditor must determine if the sample results are reliable and therefore usable in the formulation of an audit position. This is accomplished in part by assessing the sample's precision amount in relation to the degree of sensitivity of audit risk factors. When the sampling results are deemed to be reliable, the sample's point estimate can be included in the formulation of the audit recommendation. One benefit of a properly executed statistical sample application is that it provides a mathematical estimate of the achieved confidence interval. When statistical sampling is used, the results may be validated in terms of how far the sample projection (point estimate) might deviate from the value that could be obtained by a 100 percent check.

b. Auditors will use the Agency EZ-Quant software to evaluate statistical sampling applications. The auditor will input exception amounts for the items examined into the EZ-Quant's Statistical Sampling Module and use the "Show Projection, Confidence Interval" button to project the sample results and compute a point estimate. A 90 percent confidence level should initially be used to compute the precision amount and evaluate the reliability of the sample results. The sample's achieved precision is computed by EZ-Quant.

c. There are many different factors that should be considered before an auditor decides whether to rely on sample results. Ultimately, the decision of whether to accept and use the projected sample results is based on auditor judgment. Some factors which should be considered in deciding whether to use a sample's projected results are:

(1) Achieved Precision Error Percentage:

(i) Auditors should calculate the achieved precision error percentage (Precision Amount/Point Estimate) and compare it to the point estimate. If the achieved precision error percentage is 25 percent or less, the sample should generally be considered acceptable for projection purposes and inclusion in the audit recommendation.

(ii) There may be instances when the achieved precision error percentage is not as small as desired. At this point auditors should reevaluate to determine if the initial sample reliability objectives are still required to support an audit position. It may be appropriate for auditors to revise sample reliability objectives which may still allow the achieved sample results to be used in the formulation of an audit opinion. For example, the auditor may be willing to accept a wider confidence interval (that is, a larger precision error percentage) when evaluating (and performing a sampling of) elements of a cost type proposal because of the lower inherent level of audit risk with that contract type than would be expected in a fixed price evaluation. Or for example, other audit tests may have been performed that provide additional support for, and acceptance of, achieved sample results.

(2) Reassess Sample Size and/or Confidence Level:

(i) The auditor should review the achieved sample results to determine whether using the initial planned 90 percent confidence level is still appropriate. If the confidence interval is very large (relative to the point estimate), the auditor should consider increasing the sample size or consider acceptance of a reduced confidence level. Using the initial target 90 percent confidence level may have resulted in an excessively wide confidence interval. The auditor can also consider evaluating the sample using a lower confidence level such as 80 percent if the auditor's overall assessment of audit risk supports a reduced sample reliability requirement. For example, if no deficiencies have been reported on the contractor's systems, or the account under review is not of a sensitive nature or there have been few findings in the past and/or the audit type is considered to be low risk, a lower confidence level may be acceptable. Lowering the confidence level does not change the point estimate but does provide a narrower confidence interval.

(ii) The use of a confidence level below 80 percent is not recommended when the sampling test is the sole basis for supporting an audit position. Sampling applications using less than a 80 confidence level should be supplemented with additional audit tests of the same assertion, that when combined provide the auditor with sufficient appropriate audit evidence to afford a reasonable basis for an opinion. When initial audit sampling results do not provide the level of reliability desired, the auditor has the option to expand the sample size if appropriate or to design additional audit tests, to support audit conclusions and recommendations.

(3) Based on the above criteria including any other relevant knowledge, the auditor will determine whether the necessary degree of sample reliability has been achieved before using the projected sample results in the formulation of the audit recommendation. The sample evaluation is a required and critical step. Rationale used in determining whether a sample's result is acceptable in support of an audit position must be adequately documented in the audit working papers.

B-600 - Data Stratification for Audit Purposes

B-601 Introduction

This section discusses the general stratification of contractor data for audit purposes.

B-602 Definition of Stratification

Stratification is the partitioning of the audit universe into smaller groups according to a scheme that suits audit purposes. The audit universe consists of all the transactions or other basic auditable items within the scope of the audit. Stratification does not change the audit universe. Stratification is primarily used in variable sampling, and rarely used in attribute sampling.

B-603 Auditing Large Data Bases

To obtain the required evidential matter on which to base an opinion, the auditor must often deal with large volumes of data, in a short period of time. The examination of properly selected statistical samples is usually the most practical method of achieving timely audit coverage of a large number of transactions from the contractor's data base. An often considered alternative, examination of only the high-value items in an audit universe, provides limited (though at times substantial) coverage. It yields no objective audit evidence concerning the rest of the audit universe, which often is a substantial omission. Another simple alternative is unrestricted (simple) random sampling of the entire audit universe. It provides complete coverage but is generally less precise than stratified random sampling alternatives. Effective (full coverage) auditing of large audit universes and efficient sampling of them usually require that the audit universe be stratified into groups of items that are broadly similar in terms of potential individual audit findings.

B-604 Purpose of Stratification

a. The usual purpose of stratification in contract audit sampling is to enhance sampling precision and thereby decrease the amount of auditor time required to obtain adequate support for the auditor's conclusions. Stratification for this purpose is based on the assumption that a relationship exists between the variable or characteristic the auditor wishes to measure (the audit variable), usually unallowable or otherwise questioned costs, and one or more other variables or characteristics (stratification variables). Except for examined items, the audit variable values are unknown. Stratification variable values must be known for all items and it must be possible to classify (stratify) all items into groups based on them.

b. Stratification helps reduce sampling error; however, it may be called for by other audit goals. For instance, it may be desirable to deliberately focus on some subset of the audit universe, such as certain types of services, in which case all relevant audit universe items would be allocated to their own stratum. In this instance, it would still be possible to create secondary strata, based on other stratification criteria, within these primary strata.

c. Stratification may be done strictly for practical reasons related to the nature of the sampling frame. The sampling frame is the listing of universe items, electronic or otherwise, where the mechanics of sampling are applied. If the sampling frame consisted of dissimilar parts so that, for example, the frame for one part of the universe is electronic and the rest is a printed listing, the sampling mechanics for each would be different. In this case, it would make sense to create a stratum for each component of the sampling frame.

B-605 Types of Stratification

a. The most common single basis for stratification in contract audit sampling is the recorded dollar amount of the individual universe items. The typical audit variable is the questioned amount, and some correlation between it and the recorded amount is generally expected (that is, large questioned amounts are more likely to be found in larger items than in smaller ones and smaller questioned amounts are more likely to be found in smaller items). With dollar-based stratification, the largest items are often set aside in a full-analysis, non-sampling stratum, and the rest of the items either comprise a single sampling stratum or are divided into two or more sampling strata based on dollar ranges of the recorded values. Separate samples are taken from each group. Usually, the range of values for all non-zero audit findings will be relatively large, but the range of such values within each stratum will be smaller. This feature makes it possible to achieve a desired level of sampling precision with fewer sample items than would otherwise be the case.

b. Other bases for stratification are possible, either instead of or along with dollar-based stratification. In many situations, the auditor may believe that other characteristics of the universe items significantly affect the probability or amounts of errors. For example, unallowable costs may be more frequently encountered in vouchers that relate to certain types of transactions, departments, or payees. The transactions from a particular group of departments, for example, may be assembled in a single stratum and perhaps further subdivided into or two or more dollar-based strata.

B-606 Stratification in Concurrent Auditing

a. Ordinarily, contract audit sampling is used in situations where the size of the audit universe is known and will not change. If sampling is to be used in concurrent auditing however, at least some sampling must be performed before the entire universe is fully formed and is, therefore, known. A relatively simple way to adapt standard sampling methods to this situation is to stratify the audit universe by time period. Once a period has passed and the magnitude of its stratum is known, it can be sampled and evaluated while the next period's stratum is being formed. Upon completion of the final period's sample, the results for all strata can be brought together in a single stratified sample evaluation, just as for a typical stratified sample.

b. Period-based strata can themselves be stratified by dollar amount. It is typically reasonable to expect that the magnitude of any error in an item be at least loosely correlated with its size. Dollar-based subdivision of period-based strata into, say, two strata each would take advantage of most of the precision-enhancing potential of such stratification, particularly for period-based strata that have a relatively narrow range of dollar values. Alternatively, dollar unit sampling (a substitute for dollar-based stratification) can be used within the period-based strata.

B-607 Stratification by Dollars

a. The number of dollar strata appropriate in an audit application will depend on (1) the dispersion of dollar values and (2) the audit time required to accomplishing the stratification. If all items are of approximately the same amount, stratification by dollar value will serve no useful purpose. On the other hand, if items vary widely in amount, like with many types of expenses within overhead pools or bills of material, examination of all large amounts and stratification of the remaining items into several dollar ranges can substantially increase the effectiveness of audit time devoted to examining the sample items. However, consideration must be given to audit time required to accomplish the stratification. If automated (computerized) stratification is not available, further manual stratification (after the identification of high-dollar items) may require more audit effort than is justified by the increased efficiency obtained from stratification.

b. To provide sufficient coverage of both high and low dollar transactions and to reduce the risk of missing significant monetary errors, dollar stratification may be necessary. The auditor may obtain satisfactory stratification by dividing the universe into approximately equal dollar strata. For example, assume the following:

Dollar Amount	No. of Items	Total Amount
0-9,999.99	1,400	$ 2,800,000
10,000-19,999.99	150	2,000,000
20,000-29,999.99	65	1,500,000
30,000-39,999.99	35	1,200,000
40,000-79,999.99	45	2,500,000
80,000 and over	60	20,800,000
	1,755	$30,800,000

If we decide to examine all 60 items over $80,000 and sample from three dollar-based strata, the following stratification plan would be reasonable:

Stratum	Dollar Range	Total Amount
1	0-9,999.99	$ 2,800,000
2	10,000-29,999.99	3,500,000
3	30,000-79,999.99	3,700,000
	80,000 and over	20,800,000
		$30,800,000

The initial sample may be distributed equally among the strata or approximately in proportion to the dollar value of items in each stratum. For example, an initial sample of 100 items could be distributed 28 to stratum 1, 35 to stratum 2, and 37 to stratum 3.

c. The stratified physical unit sample selection option of EZ-Quant can be used to stratify a universe and select a sample as described in B-506.1b. Contractor IT systems can be used to stratify the universe as discussed in B-706.

d. Sample results may indicate a need for additional stratification. For example, the sample may identify additional accounts or types of transactions that contain unallowable costs or for some other reason are sensitive. Stratification of these accounts or transactions for more intensive sampling can be accomplished at this time.

e. Dollar unit sampling (DUS) eliminates problems associated with determining stratum boundaries, allocating sample sizes among the strata, and evaluating results when costs are questioned in some strata and not in others.

B-608 Use of Information Technology for Stratification

a. The contractor's information system can be used to stratify the universe provided that the procedures are deemed valid and reliable.

b. The contractor's information system can be used to obtain listings (electronic or otherwise) which facilitate EZ-Quant sample selection. This can be best accomplished by using fourth-generation data retrieval software (e.g., SAS) to extract the desired types of data from one or more data files. Alternatively, the items can be listed in ascending or descending order, dollar value, or have all items within specified dollar limits segregated into different data files.

c. The auditor's examination of proposed bills of materials (BOMs) can present special problems if:

- items are listed by part number within assemblies and subassemblies and

- the same items are used in a number of different assemblies and subassemblies.

The audit will be greatly facilitated if the contractor's equipment is used to:

(1) sort BOM items by part number,

(2) compute total proposed costs for each part, and

(3) print (preferably to an electronic file) information on each part (description, quantity required, unit price, and total price) in descending order of proposed cost.

In addition to facilitating the selection of a statistical stratified sample, such listings may disclose inconsistencies in pricing the same item in different locations in the bill of materials. Information on the total quantity requirement for a part is also needed to evaluate the price where quantity discounts are available.

d. Some contractors have programmed sample selections for DCAA auditors or use commercial data retrieval programs to obtain sample selections requested by DCAA.

(1) When using a sample selected by the contractor's software, additional information (e.g., possible risks, input/output files, program used, method of sample selection, etc.) should be documented, including any additional information or audit procedures required when using contractor supplied samples. The auditor should have access to all input/output relating to sample selection.

(2) While properly documented contractor selections are generally acceptable, the use of data retrieval programs developed or supported by DCAA is preferred because they provide greater control and versatility.

B-700 - Random Selection Methods

B-701 Introduction

This section discusses and illustrates the unrestricted and systematic random methods of selecting samples for physical and dollar unit sampling. The use of information technology (IT) to assist in sample selection is discussed in B-706.

B-702 Random Selection

a. Statistical sampling depends upon the principle of random selection. In sampling, the terms "random" and "haphazard" selection have completely different meanings. Haphazard selection is a nonstatistical sample selection method attempting to approximate a random selection. The sampling units are selected without any conscious bias, or without any special reason for including or omitting items from the sample. Sampling units are not selected in a careless manner, but are instead selected so the auditor expects the sample is representative of the population. The laws of probability govern random selection. For example, in selecting one voucher at random from a group of 10, the likelihood or probability that any specific voucher is selected is one chance in 10. This probability is known and can be specified because the only factor involved in random selection is the element of chance.

b. To select randomly is to eliminate personal bias or subjective considerations (which cannot be expressed numerically) from the choice of a sample. Random sampling is a selection process in which each item in a stratum has a known probability (chance) of being selected. Although the results of repeated random samples from a given universe will not all be the same, the differences will be the result of chance and not personal bias.

c. With DUS, each dollar individually has an equal chance of selection. Collectively, the dollars making up an item give that item a chance of selection proportionate to its size in the universe. Dollar unit sampling is sometimes referred to as "probability proportionate to size" (PPS) sampling. In order to evaluate the dollars selected, the items, documents, or records containing those dollars must be analyzed (See B-503.2).

d. The two basic random selection procedures are unrestricted random selection and systematic random selection. In unrestricted random selection, each item is drawn completely at random from the universe. The systematic random selection method selects sample items at a uniform interval after a random start. A wide variety of statistical sample designs might be used in contract auditing, but implementation of any of the designs involves the use of one of these two basic procedures or a modification or a combination of them. Methods of using random numbers to obtain unrestricted random selections under various circumstances are described in B-704. Systematic random selection is described in B-705.

B-703 How Randomness May Be Obtained

a. How can an audit sample be selected in a random manner? In the case of 10 items, this could be accomplished as follows: record the serial number (or other identification symbol) of each of the 10 items on a separate tag or slip of paper. Place the tags or papers in a container and mix them thoroughly. Then withdraw the required number for the sample. This procedure is feasible when the universe is very small, but difficulties become quite apparent when the universe contains thousands of items (such as vouchers, records, or units of equipment). Random numbers and computer selection routines provide the means for overcoming such difficulties.

b. The selection of random numbers is simplified by the use of quantitative software. Random numbers, which fall in auditor-specified range(s), can be produced in sequences of either single numbers or sets of numbers, depending on the option used. The random number feature of EZ-Quant produces a sequence of random numbers, singly or in sets, which contains no repeats of individual numbers or sets (for sampling without replacement) or allows duplicate numbers or sets (for sampling with replacement). The sequences are available in both the order generated and ascending order.

c. Random numbers and sets of random numbers can be generated using the EZ-Quant software. For example, auditors frequently encounter the problem of obtaining samples of unnumbered vouchers, materials, employees, or other items from listings. Combinations (sets) of two numbers, the first corresponding to a page number and the second to the position of an item on the page, usually provide a convenient method for selecting samples of unnumbered items. Other cases of sample selection might involve other characteristics of the sample items, such as the month, week, and day the item was first recorded.

B-704 Unrestricted Random Selection Procedures

B-704.1 Items Identified by a Single Series of Consecutive Numbers

The simplest use of random numbers to select a sample occurs when the selection is made from a file of consecutively numbered documents or from a listing of consecutively numbered items. For example, suppose that:

(1) the universe contains 5,000 documents which are to be sampled,

(2) these documents are numbered in sequence from 1 through 5,000,

(3) stratification of the sample is unnecessary since it is known that no high dollar or sensitive items are included in the documents, and

(4) the desired sample size is 125.

A list of random numbers can be supplied by the random number option of EZ-Quant, or it can be derived from a table of random numbers.

B-704.2 Items Identified by Sets of Numbers

a. In many accounting situations, a document or transaction is more readily identified by a combination (or set) of numbers. A combination may consist of a page number plus a line number on that page. It could also consist of a time period plus a document number as illustrated in the following example.

b. Some accounting methods call for documents to be numbered in sequence, by month or other period, commencing with "1" at the beginning of each period. If the documents to be sampled cover several such periods, selection of an unrestricted random sample presents the problem of either sampling each period separately or sampling all periods collectively with random numbers that identify both a period and document number in the period. If it is decided to sample each period separately, the random number option of EZ-Quant can be used to select the sample from consecutively numbered documents within a given period. Suppose, however, that the audit objective is to determine, by test-checking, certain characteristics of 125 documents covering a period of 12 months. A single sample will be taken for all months combined. Assume that each month's documents are numbered in sequence commencing with 1 and the quantity issued in a month varies from 500 to 800. A list of random number pairs can be supplied by the random number sets option of EZ-Quant, the first number in a pair ranging from 1 to 12, the second number in a pair ranging from 1 to 800. Alternatively, a list of random numbers pairs can be developed manually from a table of random numbers.

B-704.3 Numbers Which Represent Items Not Included in the Universe

a. Often, numbers that fall within the range of document numbers cannot be used. For example, some numbers may:

(1) correspond to voided documents,

(2) identify documents previously selected for examination because of their high dollar value or sensitivity, and

(3) relate to types of transactions which are not included in the universe.

It is possible to determine the usability of each random number as it is selected and discard those that cannot be used before proceeding to the next number. In many cases, however, it is easier to initially obtain more numbers than needed and later discard those which are not usable.

b. Suppose, for example, that a file of 7,000 vouchers contains approximately 5,000 vouchers of Type A and about 2,000 of Type B, and that both are intermingled and numbered in sequence from 1,427 to 8,426. Each voucher must be examined to determine whether it is Type A or Type B. A sample size of 125 Type B vouchers is desired. Since the two types are intermingled and the Type B vouchers comprise about 2/7ths of the total, our random numbers will probably identify only 2 of the Type B vouchers for every 7 selected. Therefore, to have a reasonable chance of identifying 125 Type B vouchers, at least 438 random numbers should be selected (the desired sample size, 125, times the ratio of total vouchers to Type B vouchers, 7/2).

c. In the above example, the first step is to select 438 random numbers in the range 1,427 to 8,426 using the random number option of EZ-Quant. As each voucher is drawn, determine if it is Type A or Type B. Return the Type A vouchers to the file and retain the Type B vouchers. Continue until 125 Type B vouchers are selected. If less than 125 Type B vouchers had been selected after evaluating all 438 vouchers, continue the selection process until 125 Type B vouchers are selected.

B-705 Systematic Random Selection

a. The systematic random selection procedure selects sample items on a fixed or uniform interval after a random start. The uniform interval between selected sample items is obtained by dividing the estimated number of universe items by the number of sample items to be selected. The random start is the first number, selected from a random digit table or generated by random number software, which falls within the uniform interval.

b. Systematic random selection is frequently used in manual selections and automated (computerized) selections because it is often easier to program and control than unrestricted random selection. Some conditions and circumstances under which the systematic method may be used for document selection are as follows:

(1) When items to be sampled are documents that are neither listed nor serially numbered or, if numbered, are not filed in numerical sequence.

(2) When items to be sampled are not suitably listed or numbered and are intermingled with other items which are not to be sampled.

(3) When items in the universe are numbered in blocks of numbers with some blocks not being used.

(4) When using DUS.

c. If there is a pattern or arrangement in the universe where items with special or significant characteristics occur at regular intervals, the auditor should ensure that items to be selected include, but not be limited to, these special or significant items. For instance, if every 24th payroll record is that of a supervisor and the auditor's sampling procedure calls for selection of every 24th item, the interval should be revised to ensure that the sample does not consist only of records covering supervisors. On the other hand, there should be a chance of including supervisors' records unless they comprise a separate stratum. The existence of a specified order of the sampling units does not mean that systematic random sampling cannot be used.

d. The usual method of obtaining a dollar unit sample is by systematic random selection. With this selection method, the universe does not have to be arranged in any particular order. To preclude a potential universe arrangement problem, the EZ-Quant DUS software will randomize the universe prior to sample selection. Normally, all item values greater than the interval are selected for 100 percent evaluation; the remainder are sampled randomly.

B-705.1 Examples of Use

a. Example 1. - Audit application where universe items:

(1) are not listed or numbered sequentially or

(2) are numbered but not filed in numerical order:

(a) Assume that a sample size of 125 is desired from a universe of approximately 11,100 items. (When the universe size is not known, it should be estimated as closely as practicable.) The sampling interval of 88.8 is obtained by dividing 11,100 by 125.

(b) Select a random number contained in the interval. This example assumes this number to be 23.

(c) Starting with the 23rd item in the universe, select every 88th item until the universe has been covered. Note that the interval number 88.8 was reduced to 88 by dropping the fraction. When an interval number is not an integer, the fraction is dropped. In this case, dropping the fraction results in a sample size slightly larger than 125.

b. Example 2. - Audit application where the universe items:

(1) are intermingled with other items and

(2) are not suitably numbered:

(a) Assume approximately 11,100 items to be examined are intermingled with about 15,000 which are not to be examined. Assume a sample size of 125.

(b) Proceed by dividing 11,100 by 125, obtaining the interval number of 88.8, which is reduced to 88. Select a random start number from 1 to 88. Assume this to be 23.

(c) Starting with the 23rd item in the universe, select every 88th item. This procedure will result in the selection of approximately 297 items, of which about 126 should be of the type to be examined (i.e., multiply the sample size of 297 items times the ratio of desired type of items to total items (11,100 divided by 26,100) which equals 126 items).

c. Example 3. - Audit application where the universe items are numbered in broken sequences:

(1) Assume approximately 3,400 vouchers in the universe are numbered serially as follows:

First 342: Vol. Nos. 8,102 through 8,443, next 1,819: Vol. Nos. 11,651 through 13,469, next 1,154: Vol. Nos. 21,891 through 23,044, next 85: Vol. Nos. 25,000 through 25,084.

(2) Assume the sample size is 125. Divide 3,400 by 125, obtaining an interval number of 27.2. Reduce this to 27.

(3) Select at random a number from 1 to 27. Assume this number is 15.

(4) Determine and list the serial numbers of vouchers to be selected in the following manner:

(a) The first voucher number to be selected is No. 8,116 (No. 8,101 plus 15). Note that although voucher number 8,101 is not in the universe, it must be used as a base for adding the random number since adding the random number to the first voucher would prevent its selection. The next number is 8,143 (8,116 plus 27). The third is 8,170 (8,143 plus 27). Continue to list each 27th number. The last voucher to be listed in the first 342 is number 8,440.

(b) The next voucher number to be listed is 11,674, which is in the second group of 1,819, determined as follows: Since the last voucher in the first group of 342 to be listed was No. 8,440, there were three vouchers left in this group. Therefore, the first voucher to be listed in the next group of 1,819 is the 24th voucher, which is No. 11,674 (11,650 plus 24). The second voucher number to be selected in this group is 11,701 (11,674 plus 27).

(c) In this manner continue to determine and list each remaining 27th voucher, until the universe has been covered. In this case there will be a few more than 125 items since the interval was reduced to 27.

(5) A variation of the method described above is to use four random starts, one for each block of numbers, instead of 1 random start. Assume these to be 8, 11, 17, and 20. Starting

with the 8th voucher in the first 342, (No. 8109) list each succeeding 27th voucher in this group, making a total of 13. The numbers of these 13 vouchers are: 8109, 8136, 8163, 8190, 8217, 8244, 8271, 8298, 8325, 8352, 8379, 8406, and 8433. In a like manner, select each 27th voucher in the remaining three groups, commencing with the appropriate random start.

d. Example 4. - DUS audit application:

(1) Divide the population dollars by the sample size to determine the interval. Assume this to be 105,697 divided by 50 to obtain 21,139.

(2) Select a random start number contained in the interval. Assume 9,872.

(3) Beginning with dollar 9,872, every 21,139th dollar is selected for evaluation. Cumulative subtotals of the population values, excluding those greater than the interval, are necessary to identify the documents containing the dollars of interest. The dollar unit sample selection option of EZ-Quant performs all calculations required to select a sample and obtain control totals for later input to the EZ-Quant sample evaluation option.

(4) Since the total population used to determine the interval might contain items that are later removed for 100 percent evaluation, the combined number of items selected probably will be less than that used to determine the interval. Normally, this will not degrade the results of the random sample. However, as with other methods of sampling, a sample size as large as could reasonably be foreseen should be obtained to provide for expansion. The preliminary sample will be a random selection from the total.

B-706 Use of Information Technology to Assist in Sample Selection

a. EZ-Quant is an automated tool designed to assist auditors in statistical sampling. As discussed in 4-605e, computer systems should be used to the maximum extent to improve auditor productivity, the stratification of contractor data, the accuracy of sample selection and evaluation, and the documentation of sampling plans and results of sampling. The reasons for not applying this technology should be documented in the working papers.

b. Use of EZ-Quant can be further enhanced through integration with various data retrieval techniques. Examples include (1) the use of fourth-generation data retrieval software (e.g., SAS, Focus, and Decision Analyzer) and (2) the application of Integrated Audit Workstation technology to automate recurring retrieval/sampling applications.

c. As is the case with any computer application, DCAA auditors should be sensitive to the need for strong internal controls as they relate to the integrity of data and its processing. Auditors applying this technology should review FAO risk assessments and internal control evaluations to establish a degree of confidence that data retrieval and sampling will not be compromised. Typically the aforementioned automated sampling tools will provide summary data on universe size as well as other statistics. The data can be compared to various contractor submissions to further improve auditor confidence in the contractor's system.

d. Documentation of the use of automated sampling tools and related techniques in audit working papers is important and should include:

(1) a narrative description and flowchart of the process in sufficient detail to enable an understanding of computer files used;

(2) record layouts and definitions of data fields used;

(3) operations performed, such as merging, sorting, computational, and/or extraction operations;

(4) software employed; and

(5) source computer file(s) and output file(s) produced

e. Operating instructions for the automated sampling tools and technical assistance in implementing data retrieval and sampling applications can be obtained through Regional Information Systems Division or the Technical Audit Services Division (OTS).