Statistical Sampling Guide

for Physical Inventory Audits
(Simple Random Sampling)

Presentation by
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Introduction

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Nelson Garcia has over 35 years of experience in the field of Naval Logistics, and a DAWIA Level III certification in Lifecycle Logistics. Holds degrees in Computer Science, and Information Systems, and is currently an adjunct professor of computer information systems at Florida Institute of Technology. Nelson Garcia was previously an academic instructor of computer science and mathematics at Prince George's County Community College.

Introduction (Cont.)

- Reference Background Material
  - American Institute of Certified Public Accountants (AICPA). *Statement of Auditing Standards (SAS) No. 39: Audit Unit (AU) 350: Audit Sampling*. New York, NY: AICPA. 2008.
  - Guy, D. M., Carmichael, D. R., & Whittington, R. (1998). *Audit Sampling: an introduction*. Wiley.
  - United States Office of Management and Budget (OMB) Circular No. A-123, Management's Responsibility for Enterprise Risk Management and Internal Controls, OMB: July 2016.
  - United States General Accounting Office. *Using Statistical Sampling. (GAO/PEMD 10.1.6)*, May 1992.
  - United States General Accounting Office. *Financial Audit Manual, Volumes 1 and 2. (GAO 08-585G)*, July 2008.

Steps for Statistical Sampling

Planning

1. Establish statistical parameters
2. Calculate Sample Size

Selection

3. Generate/Draw the Sample

Evaluation

4. Collect data / Test Sample
5. Analyze data and Report

Establish Statistical Parameters

- In order to conduct a statistical sampling inventory, establish the parameters:
  - Confidence level (e.g. 95%)
  - Confidence interval (or margin of error) (e.g. ± 5%)
  - Population size (if known)
- In some cases, these parameters are prescribed/dictated by policy

Calculate sample size

FORMULA 1:

If population size is not known

$$n = \frac{Z^2 * p(1-p)}{c^2}$$

Where:

n = sample size

Z = standard score

p = estimated probability (i.e. estimated accuracy of the inventory program; use 0.5 if not known)

c = confidence interval (margin of error)

Calculate Sample Size (Cont.)

FORMULA 2

- If population size is known. Adjustment for finite population:

$$n_1 = \frac{n}{1 + \frac{n-1}{N}}$$

Where:

n = sample size (from Formula 1)

n_1 = new sample size

N = population

Example:

If the previously calculated n was 84 and the population was 4,000:

$$n_1 = \frac{84}{1+\frac{84-1}{4{,}000}} = \frac{84}{1+\frac{83}{4{,}000}} = \frac{84}{1+0.02} = \frac{84}{1.02} = 82$$

Calculate Sample Size (Cont.)

- Can be easily determined using published tables

Required Sample Size†

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

Calculate Sample Size (Cont.)

- Can also be easily computed in Excel. Example:

	A	B	C
1			
2	**Statistal Sampling Parameters**		
3	Confidence Level	0.95	=NORM.S.INV((B3/2)+0.5)
4	estimate	0.5	
5	margin of error	0.025	
6			
7			
8	**n**		**=(C3*C3*B4*(1-B4))/(B5*B5)**
9			
10	population size	5000	
11			
12	**n1**		**=C8/(1+((C8-1)/B10))**
13			

Generate/Draw the Sample

- The next step is to select the samples at random. Each member of the population must have an equal probability of selection in order to maintain statistical validity of the sample.
  - Example: if the calculated sample size was 84, the auditor would use a random method to select 84 members of the population.

Arbitrary selection such as selecting items based on convenience is not "random selection" and invalidates the statistical sample.

Collect the Data / Test the Sample

- For audit sampling, determine:
  - Data elements involved (i.e. material number, bin location, quantity, condition, owner, etc.)
  - Which elements constitute a match or discrepancy
- Determine if discrepancies must be validated (i.e. second count) and the process to follow.
- Establish a controlled documentation process and data retention.

Analyze the Data and Report

- Each of the selected samples is measured against a criteria (i.e. physical inventory quantity observed against some inventory record). The outcome of each test, in this case, is binary (match/no-match).
- The proportion of all the outcomes is calculated.
  - Example: 81 successes out of 84 tests = 81/84 = 0.964 (or 96.4%)

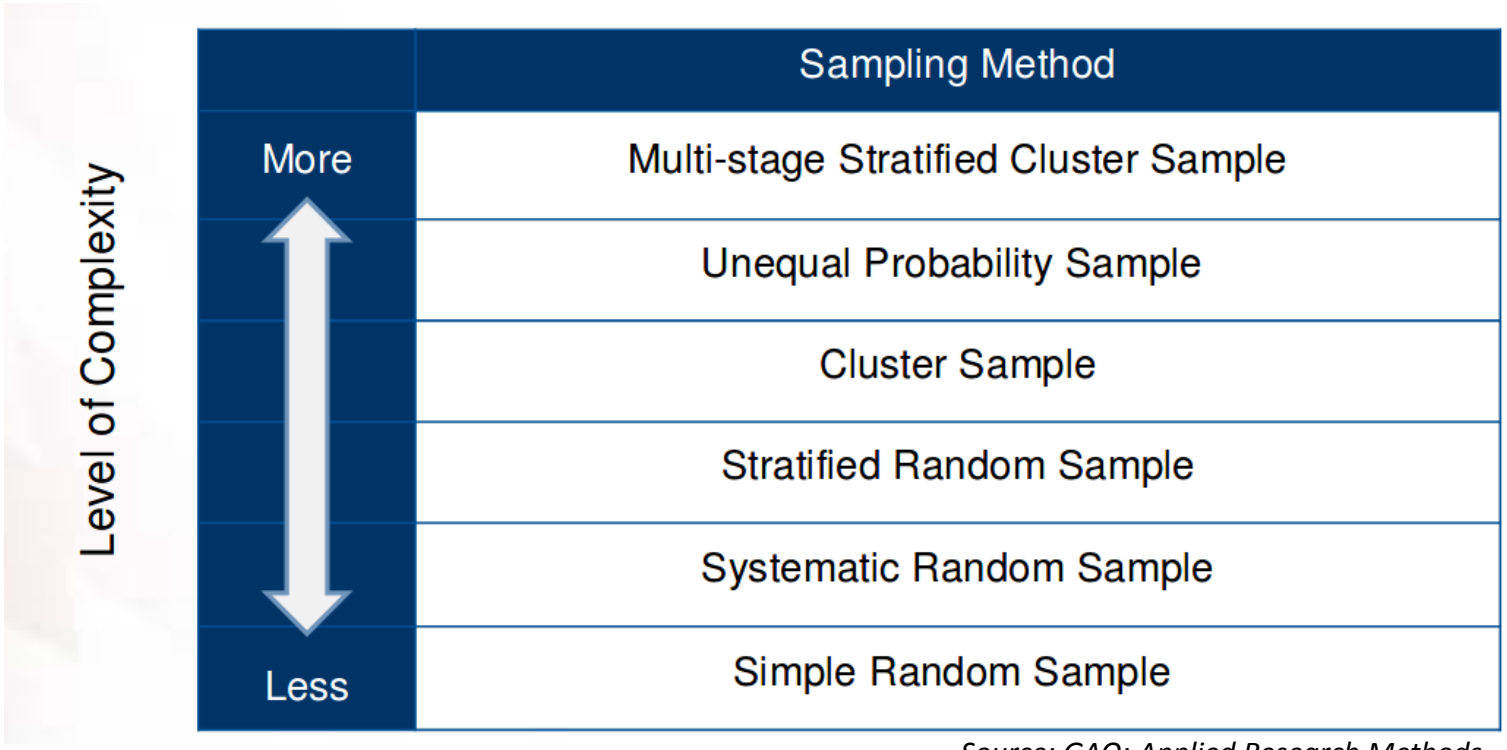
Therefore, if the audit used a 95% confidence level and a margin of error (confidence interval) of ±3%, the above results can be reported as:

"The results of the audit sampling indicate that inventory accuracy is between 93.4% and 99.4%, at the 95% confidence level."

Or simply,

"Inventory accuracy is 96.4% with a ± 3% margin of error (95% confidence)"

More Advanced Methods



Source: GAO: Applied Research Methods

Note: Simple Random Sampling (SRS) is adequate for inventory accuracy audit purposes. Stratified Random Sampling, although slightly more complex, is very similar to SRS. Anything above that, would be too costly/complex, unless the goal is to analyze other problems.

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For questions, updates, or corrections, contact:

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