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Auditor's Approach to Statistical Sampling, Volume 4. (Supplementary Section) Discovery Sampling

American Institute of Certified Public Accountants. Professional Development Division. Individual Study Program

(Supplementary Section) 4

AN AUDITOR'S APPROACH TO STATISTICAL SAMPLING

DISCOVERY SAMPLING

Individual Study Program
Professional Development Division
American Institute of Certified Public Accountants

NOTICE TO READERS

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DISCOVERY SAMPLING

SUPPLEMENTARY SECTION

Programed for the
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APPENDIX I

DEVELOPMENT OF DISCOVERY SAMPLING VALUES BINOMIAL DISTRIBUTION

I-1. In some cases, an auditor may wish to develop tables which provide sample sizes other than those which appear in Exhibit I. This section will explain how this can be done such that, for any desired sample size, n, the auditor can determine P, the probability of including at least one occurrence in a sample for any given value of p, the true population rate of occurrence.

(No answer required)

I-12. Determine the logarithm of the following numbers.

313	2.4955
31.3	_____
3.13	_____

I-23. Locate 5105 in the logarithm table. It occurs on line 32, column 4. Therefore, the first 3 digits of the corresponding number are 324. Now locate 6274 in the logarithm table. It occurs on line _____, column _____. Therefore, the first 3 digits of the number are _____.

No answer required	I-2. For populations greater than 10,000, the probability, P, of including at least one occurrence in the sample can be determined from the following formulae: (1) $Q = (1 - p)^n$ or, expressed in logarithms, $\log Q = n \log (1 - p)$, and (2) $Q = 1 - P$ Since P is the probability of finding at least one error, then Q must be the probability of finding (ONE/ZERO) errors.
1.4955 .4955	I-13. When there are <u>no</u> digits to the left of the decimal, the whole number value is determined by <u>adding</u> 1 to the number of 0's and reversing the sign. Thus, for .0275, the whole number value is -2 (1 + 1). For .00275, it would be -3, and for .000275, it would be _____.
42 4 424	I-24. Once the three whole digits have been determined, the next step is to locate the decimal. The decimal is located after the (x + 1)th digit, where x is the value to the left of the decimal in the logarithm. Thus, in converting the logarithm 2.6274, the decimal appears after the third digit. For the logarithm 3.6274, the decimal appears after the fourth digit. To convert the logarithm 1.6274, the decimal would appear after the _____ digit.

ZERO	I-3. Refer to Worksheet 5 (Page S-42) in this section. The auditor seeks to determine the reliability (probability), P, of including at least one occurrence in a sample size of _____ if the true population occurrence rate is _____.
−4	I-14. Complete the following table for whole number values of logarithms of the numbers shown. 386 2 38.6 ___ 3.86 0 .386 ___ .0386 −2 .00386 ___
second	I-25. Convert the logarithms below to real numbers. 1.6274 42.4 .6274 ____ 2.6274 ____

160 .01 (1%)	I-4. Complete Line (A) on Worksheet 5.
1 −1 −3	I-15. To determine the logarithm of any number, select the _____ value from the tables and determine the _____ value from the digits left of the decimal or 0's right of the decimal.
4.24 424.0	I-26. If the logarithm is negative, a slightly different procedure is used. Enter the table with the complement of the decimal in the logarithm. Thus, if the logarithm were −1.7328, you would look up .2672 (1 − .7328) in the table. This occurs on line 18, column 5, and the first three digits of the number are _____.

(A) 0.99
(1.00 − .01)

I-5. Complete Line (B) on Worksheet 5 using the logarithm tables in Exhibit IV (Page S-35).

decimal

whole number

I-16. Determine the whole number values and logarithms of the following numbers:

Number	Decimal Value	Whole Value	Logarithm
275	.4393	2	2.4393
2.75	.4393	_____	_____
.275	.4393	_____	_____
.0275	.4393	_____	_____

185

I-27. To determine the location of the decimal, simply add 0's to the left of the three digits equal to the absolute value of the whole number characteristic of the logarithm. Thus, to find the number corresponding to the logarithm −1.7328, you would determine the three digits, 185, by locating _____ in the logarithm table and adding one 0 to the left of the three digits.

(B) −.0044

(If you are correct, go to Frame I-19. Otherwise, continue with Frame I-6.)

I-6. To find the logarithm of any number using logarithm tables, the tables are entered by locating the first two whole digits of the number in the left-hand column. (Ignore, for the time being, the location of the decimal.) Thus, to find the logarithm of the number 2.75, you would locate the line _____ in the left-hand column.

0 .4393

−1 − .5607

−2 −1.5607

I-17. Since the quantity (1 − p) is 0.99 on Worksheet 5, the decimal value of the logarithm from the tables is _____ and the whole number value is _____.

.2672
(1 − .7328)

I-28. To convert the logarithm −1.7696 to a real number, locate 2304 (1 − .7696) in the logarithm table. Thus, we know the three digits are _____. Next, add one zero to the left of the three digits, which produces the correct number, _____.

27	I-7. When the line is located, proceed along the line until you reach the column headed by the <u>third</u> whole digit. The logarithm appears in this column. Thus, the logarithm of 275 appears on line 27, column 5, and the logarithm of 276 appears on line _____, column _____.
.9956 −1	I-18. Calculate log (1 − p). Correct your answer on Worksheet 5.
170 .0170	I-29. Determine the number corresponding to each of the logarithms below. a. − .2993 _____ b. −1.2993 _____ c. −2.2993 _____

27 6	I-8. The logarithm of 2.75 taken from the tables is .4393. The tables give only the decimal (fractional) value of the logarithm (the right-hand side of the decimal point). Any whole value characteristic (left-hand side of the decimal) must be determined separately. Thus, the decimal value of the logarithm for 2.75, 275, 2750, etc. is the same. What is the decimal value for 375? _____ 3750? _____
−.0044 (−1 + .9956)	I-19. Enter n, the desired sample size, on Line (C) of Worksheet 5.
a. .502 b. .0502 c. .00502	I-30. Determine Q and enter your corrected answer on Line (E) of Worksheet 5.

.5740 .5740	I-9. The whole number value is determined by the number of digits to the <u>left</u> of the decimal in the original number. To determine the whole number value, subtract 1 from the number of digits to the left of the decimal. Thus, the whole number value for 2.75 is 0 (1 − 1), for 275 is 2 (3 − 1) and for 2750 is _____.
(C) 160	I-20. Complete Line (D) of Worksheet 5.
(E) .198	I-31. The value, Q, is the probability of disclosing exactly 0 occurrences in a sample where the true population occurrence rate is p. The value to be calculated in developing the tables is the probability of finding at least one occurrence. Therefore, $Q = 1 - P$ Calculate P and enter your answer on Line (F) of Worksheet 5.

3 (4 − 1)	I-10. Calculate the whole number value of the logarithm for each of the following numbers: 375 _____ 37.5 _____ 37.58624 _____
(D) −0.7040 (160 x −.0044)	I-21. What number corresponds to a logarithm of −0.7040? Enter your answer on Worksheet 5, Line (E). (Note: The notation, $\log^{-1}X$, refers to the real number which has a logarithm of X. Thus, $\log^{-1}.3010$ would equal 2 since .3010 is the logarithm of 2.)
(F) .802	I-32. Does the calculated value of P for a true occurrence rate of 1% and a sample size of 160 agree with the table in Exhibit I? (YES/NO)

2 1 1	I-11. The logarithm of the number is the sum of the whole number value and the decimal value. Thus, for 275, the logarithm is 2.4393 (2 + 0.4393), for 2750 the logarithm is 3.4393, and the logarithm for 27.5 is _____.
(E) .198 (If you are correct, go to Frame I-31. If not, continue with Frame I-22.)	I-22. Given a positive logarithm such as 3.5105, the corresponding number is determined by first locating the decimal value in the logarithm tables. For the logarithm 3.5105, the decimal value is 5105. For the logarithm 4.5105, the decimal value is _____.
YES (.802 = 80%)	END OF APPENDIX I

1.4393 (1 + 0.4393)	NOW TURN BACK TO PAGE S-1, THE SECOND ROW, AND BEGIN FRAME I-12.
.5105	NOW TURN BACK TO PAGE S-1, THE THIRD ROW, AND BEGIN FRAME I-23.

APPENDIX II

DEVELOPMENT OF DISCOVERY SAMPLING VALUES HYPERGEOMETRIC DISTRIBUTION

II-1. Appendix I discussed the development of discovery sampling values based upon the binomial distribution. Such values are applicable for populations greater than 10,000. For populations less than 10,000, the hypergeometric distribution is used. Thus, for a population of 12,500, we would use tables derived from the (HYPERGEOMETRIC/BINOMIAL) distribution and for a population of 6,000, we would use tables based upon the (HYPERGEOMETRIC/BINOMIAL) distribution.

II-9. The number of population errors, K, corresponding to the true population occurrence rate, p, is calculated by the formula

$$K = pN$$

In calculating K for populations between 2,000 and 5,000, N would be _____.

II-17. Complete Line (I) of Worksheet 6.

BINOMIAL HYPERGEOMETRIC	II-2. In the hypergeometric distribution, the probability, P, of finding at least one sample occurrence if the true population rate of occurrence is p is given by the formula $$P = 1 - Q$$ where Q, the probability of finding 0 errors, is expressed as $$Q = \left(\frac{N - n}{N}\right)^K$$ If Q, the probability of finding 0 errors, is 10%, we would expect P, the probability of finding 1 or more errors, to be _____%.
5,000	II-10. Calculate K for the problem of Worksheet 6. Enter your answer on Line (E).
(I) 87%	II-18. In the two appendices, we have seen two methods of expanding the discovery sampling tables, based upon the binomial and hypergeometric distributions. Which of these two distributions corresponds to the problem of Worksheet 6? _____

90%	II-3. In the formula, $$Q = \left(\frac{N - n}{N}\right)^K$$ the population size is N, the sample size is n, and K equals pN, the true population rate of occurrence multiplied by the population size. In other words, K is the actual number of population occurrences corresponding to a given value of p, the upper limit of population occurrence rate. If N = 7,000 and p = .01, then K would equal _____.
(E) 50 (5,000 x .01)	II-11. For a population between 5,000 and 10,000, sample size of 200, calculate $\frac{N - n}{N}$.
hypergeometric	II-19. Which distribution is used for populations greater than 10,000 items? (HYPERGEOMETRIC/BINOMIAL)

70	II-4. In each of the following cases, calculate K. N: 6,000 — n: 200 — p: .01 — K: _____ N: 3,000 — n: 500 — p: 1% — K: _____ N: 2,000 — n: 400 — p: 0.5% — K: _____
.98 $(\frac{10,000 - 200}{10,000})$	II-12. Using the Tables of Common Logarithms in Exhibit IV, determine the logarithm of $\frac{N - n}{N}$ for the problem of Worksheet 6. Enter your answer on Line (F).
BINOMIAL	II-20. To determine values for population sizes between 2,000 and 5,000, which value of N should be used? _____

60 (6,000 x .01)

30 (3,000 x .01)

10 (2,000 x .005)

II-5. In order to convert the algebraic expression for Q to one more readily calculable, we use the logarithmic expression

$$\log Q = k \log \left(\frac{N - n}{N}\right)$$

Write this expression for p = 1%, N = 5,000, and n = 300.

(F) −.0177

(.9823 − 1.0000)

II-13. Complete Line (G) of Worksheet 6.

5,000

II-21. In the hypergeometric formula with a population of 8,000, p equal to 1%, and n equal to 400, determine K. _____

$\log Q = 50 \log \left(\frac{4700}{5000}\right)$	II-6. Refer to Worksheet 6 (Page S-43) in this section. The auditor must determine the probability of finding at least one occurrence in a random sample of 200 items drawn from a population of 2,000 to _____ items if the true population occurrence rate is _____%.
(G) $-.8850$ $(50 \times -.0177)$	II-14. Evaluate Q for the problem on Worksheet 6. Enter your answer on Line (H).
K = 80 (K = pN = 8,000 x .01)	II-22. The binomial distribution is used for determining discovery sampling values in populations greater than 10,000. However, notice that the formula for the binomial distribution, $Q = (1 - p)^n$ does not include the population size. The hypergeometric values which are used for populations less than 10,000 are calculated from the following: $Q = \left(\frac{N - n}{N}\right)^K$ In this formula, population size (IS/IS NOT) a factor.

5,000 1%	II-7. The first line of Worksheet 6 requires the auditor to enter N, the population size. However, the problem specifies a population of 2,000 to 5,000 items. Whenever a range of population sizes is specified, the value of N will be the maximum population size in the range. Thus, for populations between 5,000 and 10,000, N would be 10,000. Enter, on Line (A), the correct value of N for the problem of Worksheet 6.
(H) .130	II-15. The value of Q, .130 or 13.0%, corresponds to which of the following? a. The probability of finding <u>0</u> errors in a sample of 200 items drawn from a population of 5,000 if the true population error rate is 1%. b. The probability of finding <u>one or more</u> errors in a sample of 200 drawn from a population of 5,000 if the true population error rate is 1%.
IS	END OF APPENDIX II

(A) 5,000	II-8. Complete Lines (B), (C), and (D) of Worksheet 6.
a. The probability of finding <u>0</u> errors in a sample of 200 items drawn from a population of 5,000 if the true population error rate is 1%.	II-16. If Q, the probability of finding 0 errors, is 13.0%, then the probability of finding one or more errors in a population of 2,000 to 5,000 with a 1% true rate of occurrence is _____%.

(B) 200 (C) .96 (4,800 ÷ 5,000) (D) 1%	NOW TURN BACK TO PAGE S-13, THE SECOND ROW, AND BEGIN FRAME II-9.
87.0% (100.0 − 13.0)	NOW TURN BACK TO PAGE S-13, THE THIRD ROW, AND BEGIN FRAME II-17.

EXHIBIT I

TABLE I-A

PROBABILITY IN PER CENT OF INCLUDING AT LEAST ONE OCCURRENCE IN A SAMPLE

FOR POPULATIONS OVER 10,000

If the True Population Rate of Occurrence is:

Sample Size	.01%	.05%	.1%	.2%	.3%	.5%	1%	2%
	The Probability of Including at Least One Occurrence in the Sample is:							
50		2%	5%	9%	14%	22%	39%	64%
60	1%	3	6	11	16	26	45	70
70	1	3	7	13	19	30	51	76
80	1	4	8	15	21	33	55	80
90	1	4	9	16	24	36	60	84
100	1	5	10	18	26	39	63	87
120	1	6	11	21	30	45	70	91
140	1	7	13	24	34	50	76	94
160	2	8	15	27	38	55	80	96
200	2	10	18	33	45	63	87	98
240	2	11	21	38	51	70	91	99
300	3	14	26	45	59	78	95	99+
340	3	16	29	49	64	82	97	99+
400	4	18	33	55	70	87	98	99+
460	5	21	37	60	75	90	99	99+
500	5	22	39	63	78	92	99	99+
600	6	26	45	70	84	95	99+	99+
700	7	30	50	75	88	97	99+	99+
800	8	33	55	80	91	98	99+	99+
900	9	36	59	83	93	99	99+	99+
1,000	10	39	63	86	95	99	99+	99+
1,500	14	53	78	95	99	99+	99+	99+
2,000	18	63	86	98	99+	99+	99+	99+
2,500	22	71	92	99	99+	99+	99+	99+
3,000	26	78	95	99+	99+	99+	99+	99+

Note: 99+ indicates a probability of 99.5% or greater. Probabilities in these tables are rounded to the nearest 1%. Differences in rounding techniques may cause a few entries in these tables to differ by one percentage point from comparable entries in other tables.

EXHIBIT I

TABLE I-B

PROBABILITY IN PER CENT OF INCLUDING AT LEAST ONE OCCURRENCE IN A SAMPLE

FOR POPULATIONS BETWEEN 5,000 AND 10,000

If the True Population Rate of Occurrence is:

Sample Size	.1%	.2%	.3%	.4%	.5%	.75%	1%	2%
	The Probability of Including at Least One Occurrence in the Sample is:							
50	5%	10%	14%	18%	22%	31%	40%	64%
60	6	11	17	21	26	36	45	70
70	7	13	19	25	30	41	51	76
80	8	15	21	28	33	45	55	80
90	9	17	24	30	36	49	60	84
100	10	18	26	33	40	53	64	87
120	11	21	30	38	45	60	70	91
140	13	25	35	43	51	65	76	94
160	15	28	38	48	55	70	80	96
200	18	33	45	56	64	78	87	98
240	22	39	52	62	70	84	91	99
300	26	46	60	70	78	90	95	99+
340	29	50	65	75	82	93	97	99+
400	34	56	71	81	87	95	98	99+
460	38	61	76	85	91	97	99	99+
500	40	64	79	87	92	98	99	99+
600	46	71	84	92	96	99	99+	99+
700	52	77	89	95	97	99+	99+	99+
800	57	81	92	96	98	99+	99+	99+
900	61	85	94	98	99	99+	99+	99+
1,000	65	88	96	99	99	99+	99+	99+
1,500	80	96	99	99+	99+	99+	99+	99+
2,000	89	99	99+	99+	99+	99+	99+	99+

Note: 99+ indicates a probability of 99.5% or greater.

Probabilities in these tables are rounded to the nearest 1%. Differences in rounding techniques may cause a few entries in these tables to differ by one percentage point from comparable entries in other tables.

EXHIBIT I

TABLE I-C

PROBABILITY IN PER CENT OF INCLUDING AT LEAST ONE OCCURRENCE IN A SAMPLE

FOR POPULATIONS BETWEEN 2,000 AND 5,000

If the True Population Rate of Occurrence is:

Sample Size	.3%	.4%	.5%	.6%	.8%	1%	1.5%	2%
	The Probability of Including at Least One Occurrence in the Sample is:							
50	14%	18%	22%	26%	33%	40%	53%	64%
60	17	21	26	30	38	45	60	70
70	19	25	30	35	43	51	66	76
80	22	28	33	38	48	56	70	80
90	24	31	37	42	52	60	75	84
100	26	33	40	46	56	64	78	87
120	31	39	46	52	62	70	84	91
140	35	43	51	57	68	76	88	94
160	39	48	56	62	73	80	91	96
200	46	56	64	71	81	87	95	98
240	52	63	71	77	86	92	98	99
300	61	71	79	84	92	96	99	99+
340	65	76	83	88	94	97	99+	99+
400	71	81	88	92	96	98	99+	99+
460	77	86	91	95	98	99	99+	99+
500	79	88	93	96	99	99	99+	99+
600	85	92	96	98	99	99+	99+	99+
700	90	95	98	99	99+	99+	99+	99+
800	93	97	99	99	99+	99+	99+	99+
900	95	98	99	99+	99+	99+	99+	99+
1,000	97	99	99+	99+	99+	99+	99+	99+

Note: 99+ indicates a probability of 99.5% or greater.

Probabilities in these tables are rounded to the nearest 1%. Differences in rounding techniques may cause a few entries in these tables to differ by one percentage point from comparable entries in other tables.

EXHIBIT II

TABLE 1-A

Determination of Sample Size
Percentage of Occurrences in Sample
Reliability (Confidence Level): 99%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50									0	0	0	2.0	4.0	4.0	6.0	10.0	14.0	18.0	22.0	26.0	32.0
60								0	0	0	1.7	3.3	5.0	5.0	6.7	11.7	15.0	20.0	23.3	28.3	33.3
70							0	0	0	1.4	2.9	4.3	5.7	7.1	8.6	12.9	15.7	20.0	25.7	30.0	34.3
80						0	0	0	1.2			5.0	6.2	7.5	8.8		17.5	21.2	26.2	31.2	36.2
90					0	0	0	1.1		2.2	3.3	5.6	6.7	7.8	10.0	13.3	17.8	22.2	26.7	32.2	36.7
120				0	0	.8	1.7	1.7	2.5	3.3	5.0	6.7	7.5	9.2	10.8	15.0	20.0	24.2	29.2	33.3	38.3
160			0	0	.6	1.2	1.9	3.1	3.8	4.4	5.6	7.5	8.8	10.6	12.5	16.9	21.2	25.6	30.6	35.0	40.0
240		0	.4	.8	1.7	2.5	2.9	3.8	4.6	5.4	7.1	8.8	10.4	12.1	13.8	18.3	22.9	27.5	32.5	37.1	42.1
340		.3	.9	1.5	2.1	2.9	3.8	4.4	5.3	6.2	7.6	9.4	11.2	12.9	14.7	19.4	24.1	28.8	33.5	38.5	43.5
460	0	.4	1.1	1.7	2.6	3.3	4.1	5.0	5.9	6.7	8.5	10.2	12.0	13.7	15.7	20.2	24.8	29.6	34.6	39.3	44.3
1000	.2	.9	1.7	2.5	3.4	4.2	5.1	6.0	6.9	7.8	9.6	11.4	13.3	15.1	17.0	21.8	26.6	31.4	36.3	41.2	46.2

EXHIBIT II

TABLE 1-B

Determination of Sample Size
Percentage of Occurrences in Sample
Reliability (Confidence Level): 95%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50						0	0	0	0	2.0		4.0	6.0	8.0	10.0	14.0	18.0	22.0	26.0	32.0	36.0
60					0	0	0	1.7	1.7		3.3	5.0	6.7	8.3	10.0	15.0	18.3	23.3	28.3	33.3	38.3
70					0	0	1.4		2.9	2.9	4.3	5.7	7.1	10.0	11.4	15.7	20.0	24.3	28.6	34.3	38.6
80				0	0	1.2		2.5		3.8	5.0	6.2	8.8	10.0		16.2	20.0	25.0	30.0	35.0	40.0
90				0	0		2.2		3.3	4.4	5.6	6.7	8.9	10.0	12.2	16.7	21.1	25.6	30.0	35.6	40.0
120			0	.8	.8	1.7	2.5	3.3	4.2	5.0	6.7	8.3	10.0	11.7	13.3	17.5	22.5	27.5	31.7	36.7	41.7
160		0	.6	1.2	1.9	2.5	3.1	3.8	5.0	5.6	7.5	8.8	10.6	12.5	14.4	18.8	23.8	28.1	33.1	38.1	43.1
240		.4	.8	1.7	2.5	3.3	4.2	5.0	5.8	6.7	8.3	10.0	11.7	13.8	15.4	20.0	24.6	29.6	34.6	39.2	44.2
340	0	.6	1.2	2.1	2.9	3.5	4.4	5.3	6.2	7.1	8.8	10.6	12.4	14.4	16.2	20.9	25.6	30.6	35.3	40.3	45.3
460	0	.9	1.5	2.4	3.3	3.9	4.8	5.7	6.7	7.6	9.3	11.1	13.0	14.8	16.7	21.5	26.3	31.1	36.1	40.9	45.9
1000	.4	1.2	2.0	2.9	3.8	4.7	5.6	6.5	7.4	8.4	10.2	12.1	14.0	15.9	17.8	22.7	27.5	32.4	37.4	42.3	47.5

EXHIBIT II

TABLE 1-C

Determination of Sample Size
Percentage of Occurrences in Sample
Reliability (Confidence Level): 90%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50					0	0	0	2.0	2.0		4.0	6.0	8.0	10.0	10.0	16.0	20.0	24.0	30.0	34.0	38.0
60				0	0	0	1.7		3.3	3.3	5.0	6.7	8.3	10.0	11.7	16.7	21.7	25.0	30.0	35.0	40.0
70				0	0	1.4		2.9		4.3	5.7	7.1	8.6	11.4	12.9	17.1	21.4	25.7	31.4	35.7	41.4
80			0	0	1.2		2.5		3.8	5.0	6.2	7.5	10.0			17.5	22.5	27.5		36.2	
90			0	0		2.2		3.3	4.4		6.7	7.8	10.0	12.2	13.3	17.8	22.2	27.8	32.2	36.7	42.2
120		0	0	.8	1.7	2.5	3.3	4.2	5.0	5.8	7.5	9.2	10.8	12.5	14.2	19.2	24.2	28.3	33.3	38.3	43.3
160		0	.6	1.2	2.5	3.1	3.8	5.0	5.6	6.2	8.1	10.0	11.9	13.8	15.6	20.0	25.0	29.4	34.4	39.4	44.4
240	0	.4	1.2	2.1	2.9	3.8	4.6	5.4	6.2	7.1	8.8	10.8	12.5	14.6	16.2	20.8	25.8	30.8	35.4	40.4	45.4
340	0	.9	1.5	2.4	3.2	4.1	5.0	5.9	6.8	7.6	9.4	11.2	13.2	15.0	17.1	21.8	26.5	31.5	36.2	41.2	46.2
460	.2	.9	1.7	2.6	3.5	4.3	5.2	6.1	7.2	8.0	9.8	11.7	13.7	15.4	17.4	22.2	27.0	32.0	37.0	41.7	46.7
1000	.5	1.3	2.2	3.1	4.0	4.9	5.9	6.8	7.7	8.7	10.6	12.5	14.4	16.4	18.3	23.2	28.0	33.0	37.9	42.9	47.9

EXHIBIT II

TABLE 1-D

Determination of Sample Size
Percentage of Occurrences in Sample
Reliability (Confidence Level): 85%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50				0	0	0	2.0	2.0	2.0	4.0	6.0	6.0	8.0	10.0	12.0	16.0	22.0	26.0	30.0	34.0	40.0
60				0	0	1.7		3.3	3.3	5.0	6.7	8.3	10.0	11.7	13.3	18.3		26.7	31.7	36.7	41.7
70			0	0	1.4		2.9		4.3		7.1	8.6	10.0		14.3	18.6	22.9	27.1	32.9	37.1	42.9
80			0	0		2.5		3.8	5.0	5.0	7.5	8.8	10.0	12.5		18.8	23.8	28.8		37.5	
90			0	1.1			3.3	4.4		5.6	7.8	8.9	11.1		14.4	18.9	24.4	28.9	33.3	38.9	43.3
120		0	.8	1.7	2.5	3.3	4.2	5.0	5.8	6.7	8.3	10.0	11.7	13.3	15.0	20.0	25.0	30.0	34.2	39.2	44.2
160		0	1.3	1.9	2.5	3.8	4.4	5.0	6.3	6.9	8.8	10.6	12.5	14.4	16.3	20.6	25.6	30.6	35.6	40.0	45.0
240	0	.8	1.3	2.1	3.3	4.2	5.0	5.8	6.7	7.5	9.6	11.3	13.3	15.0	17.1	21.7	26.7	31.3	36.3	41.3	46.3
340	.3	.9	1.8	2.6	3.5	4.4	5.3	6.2	7.1	7.9	10.0	11.8	13.5	15.6	17.4	22.4	27.1	32.1	37.1	41.8	46.8
460		1.1	2.0	2.8	3.7	4.6	5.7	6.5	7.4	8.3	10.2	12.2	13.9	15.9	17.8	22.6	27.6	32.4	37.4	42.4	47.1
1000	.6	1.4	2.3	3.3	4.2	5.1	6.1	7.0	8.0	8.9	10.8	12.8	14.7	16.6	18.6	23.5	28.4	33.3	38.3	43.3	48.3

EXHIBIT II

TABLE I-E

Determination of Sample Size
Percentage of Occurrences in Sample
Reliability (Confidence Level): 80%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50				0	0	2.0	2.0	2.0	4.0	4.0	6.0	8.0	10.0	12.0	14.0	18.0	22.0	28.0	32.0	38.0	42.0
60			0	0	1.7		3.3	3.3	5.0	5.0	6.7	8.3	10.0			18.3	23.3	28.3	33.3	38.3	43.3
70			0	0				4.3		5.7	7.1	8.6	11.4	12.9	14.3	18.6	24.3	28.6	34.3	38.6	
80		0	0	1.3		2.5	3.8		5.0	6.3	7.5	10.0			15.0	20.0	25.0	28.8		38.8	43.8
90		0	0		2.2			4.4	5.6	6.7	7.8	10.0		13.3	15.6	20.0		30.0	34.4	40.0	44.4
120		0	.8	1.7	2.5	3.3	4.2	5.0	5.8	6.7	8.3	10.8	12.5	14.2	15.8	20.8	25.8	30.8	35.0	40.0	45.0
160		.6	1.3	1.9	3.1	3.8	4.4	5.6	6.3	7.5	9.4	11.3	13.1	15.0	16.9	21.3	26.3	31.3	36.3	41.3	46.3
240	0	.8	1.7	2.5	3.3	4.2	5.0	6.3	7.1	7.9	10.0	11.7	13.8	15.4	17.5	22.1	27.1	32.1	37.1	42.1	46.7
340	.3	1.2	2.1	2.9	3.8	4.7	5.6	6.5	7.4	8.2	10.3	12.1	14.1	15.9	17.9	22.6	27.6	32.6	37.3	42.4	47.4
460	.4	1.3	2.2	3.0	3.9	4.8	5.9	6.7	7.6	8.7	10.4	12.4	14.3	16.3	18.3	23.0	28.0	32.8	37.8	42.8	47.8
1000	.6	1.5	2.4	3.4	4.3	5.3	6.2	7.2	8.1	9.1	11.0	13.0	14.9	16.9	18.8	23.7	28.7	33.6	38.6	43.6	48.6

EXHIBIT III

TABLE 2-A

Evaluation of Results
Number of Occurrences in Sample
Reliability (Confidence Level): 99%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50									0			1	2		3	5	7	9	11	13	16
60								0			1	2	3		4	7	9	12	14	17	20
70							0			1	2	3	4	5	6	9	11	14	18	21	24
80						0			1		2	4	5	6	7	10	14	17	21	25	29
90					0			1		2	3	5	6	7	9	12	16	20	24	29	33
120				0		1	2		3	4	6	8	9	11	13	18	24	29	35	40	46
160			0		1	2	3	5	6	7	9	12	14	17	20	27	34	41	49	56	64
240		0	1	2	4	6	7	9	11	13	17	21	25	29	33	44	55	66	78	89	101
340		1	3	5	7	10	13	15	18	21	26	32	38	44	50	66	82	98	114	131	148
4	0	2	[illegible]	[illegible]	1[illegible]	[illegible]				[illegible]	[illegible]	47	55	[illegible]	7[illegible]	[illegible]	[illegible]14	136	159	181	204
1000	2	9	17	25	34	42	51	60	69	78	96	114	133	151	170	218	266	314	363	412	462

EXHIBIT III

TABLE 2-B

Evaluation of Results
Number of Occurrences in Sample
Reliability (Confidence Level): 95%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50						0				1		2	3	4	5	7	9	11	13	16	18
60					0			1			2	3	4	5	6	9	11	14	17	20	23
70					0		1		2		3	4	5	7	8	11	14	17	20	24	27
80				0		1		2		3	4	5	7	8	9	13	16	20	24	28	32
90				0		1	2		3	4	5	6	8	9	11	15	19	23	27	32	36
120			0	1		2	3	4	5	6	8	10	12	14	16	21	27	33	38	44	50
160		0	1	2	3	4	5	6	8	9	12	14	17	20	23	30	38	45	53	61	69
240		1	2	4	6	8	10	12	14	16	20	24	28	33	37	48	59	71	83	94	106
340	0	2	4	7	10	12	15	18	21	24	30	36	42	49	55	71	87	104	120	137	154
460	0	4	7	11	15	18	22	26	31	35	43	51	60	68	77	99	121	143	166	188	211
1000	4	12	20	29	38	47	56	65	74	84	102	121	140	159	178	227	275	324	374	423	473

EXHIBIT III

TABLE 2-C

Evaluation of Results
Number of Occurrences in Sample
Reliability (Confidence Level): 90%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50					0			1			2	3	4	5		8	10	12	15	17	19
60				0			1		2		3	4	5	6	7	10	13	15	18	21	24
70				0		1		2		3	4	5	6	8	9	12	15	18	22	25	29
80			0		1		2		3	4	5	6	8	9	10	14	18	22	25	29	33
90			0		1	2		3	4		6	7	9	11	12	16	20	25	29	33	38
120		0		1	2	3	4	5	6	7	9	11	13	15	17	23	29	34	40	46	52
160		0	1	2	4	5	6	8	9	10	13	16	19	22	25	32	40	47	55	63	71
240	0	1	3	5	7	9	11	13	15	17	21	26	30	35	39	50	62	74	85	97	109
340	0	3	5	8	11	14	17	20	23	26	32	38	45	51	58	74	90	107	123	140	157
460	1	4	8	12	16	20	24	28	33	37	45	54	63	71	80	102	124	147	170	192	215
1000	5	13	22	31	40	49	59	68	77	87	106	125	144	164	183	232	280	330	379	429	479

EXHIBIT III

TABLE 2-D

Evaluation of Results
Number of Occurrences in Sample
Reliability (Confidence Level): 85%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50				0			1			2	3		4	5	6	8	11	13	15	18	20
60				0		1		2		3	4	5	6	7	8	11	13	16	19	22	25
70			0		1		2		3		5	6	7	8	10	13	16	19	23	26	30
80			0		1	2		3	4		6	7	8	10	11	15	19	23	26	30	34
90			0	1		2	3	4		5	7	8	10	11	13	17	22	26	30	34	38
120		0	1	2	3	4	5	6	7	8	10	12	14	16	18	24	30	36	41	47	53
160		0	2	3	4	6	7	8	10	11	14	17	20	23	26	33	41	49	57	64	72
240	0	2	3	5	8	10	12	14	16	18	23	27	32	36	41	52	64	75	87	99	111
340	1	3	6	9	12	15	18	21	24	27	34	40	46	53	59	76	92	109	126	142	159
460	1	5	9	13	17	21	26	30	34	38	47	56	64	73	82	104	127	149	172	195	218
1000	6	14	23	33	42	51	61	70	80	89	108	128	147	166	186	235	284	333	383	433	483

EXHIBIT III

TABLE 2-E

Evaluation of Results
Number of Occurrences in Sample
Reliability (Confidence Level): 80%

Sample Size	Precision (Upper Limit) Percentage																				
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	50
50				0		1			2		3	4	5	6	7	9	11	14	16	19	21
60			0		1		2		3		4	5	6	7	8	11	14	17	20	23	26
70			0		1		2	3		4	5	6	8	9	10	13	17	20	24	27	30
80		0		1		2	3		4	5	6	8	9	10	12	16	20	23	27	31	35
90		0		1	2		3	4	5	6	7	9	10	12	14	18	22	27	31	36	40
120		0	1	2	3	4	5	6	7	8	10	13	15	17	19	25	31	37	42	48	54
160		1	2	3	5	6	7	9	10	12	15	18	21	24	27	34	42	50	58	66	74
240	0	2	4	6	8	10	12	15	17	19	24	28	33	37	42	53	65	77	89	101	112
340	1	4	7	10	13	16	19	22	25	28	35	41	48	54	61	77	94	111	127	144	161
460	2	6	10	14	18	22	27	31	35	40	48	57	66	75	84	106	129	151	174	197	220
1000	6	15	24	34	43	53	62	72	81	91	110	130	149	169	188	237	287	336	386	436	486

EXHIBIT IV

TABLES OF COMMON LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325
43	6336	6345	6355	6365	6375	6385	6395	6405	6415	6425
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396

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EXHIBIT IV

TABLES OF COMMON LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996

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WORKSHEET 1

SOUTHERN MANUFACTURING COMPANY

In the annual audit of Southern Manufacturing Company, the auditor is examining the posting of disbursement vouchers. He is concerned that improper posting may have occurred at a sufficiently high rate that net income might be significantly in error.

For purposes of this problem, postings to balance sheet account classifications which should properly be posted to income and expense account classifications, and vice versa, will cause a misstatement of income. Therefore, such improper postings will be errors according to problem definition.

The total number of disbursement vouchers is 10,300. The auditor will examine 100% of the vouchers over $1,000. There are 500 such vouchers. For the remaining vouchers, he will use discovery sampling to determine, with 95% confidence, that improper postings do not occur in over 0.5% of the vouchers.

1. Population Size _____
2. Reliability _____
3. Maximum Occurrence Rate _____
4. Sample Size _____
5. Occurrences in Sample _____

WORKSHEET 2

TABLE I-A

PROBABILITY IN PER CENT OF INCLUDING AT LEAST ONE OCCURRENCE IN A SAMPLE

FOR POPULATIONS OVER 10,000

If the True Population Rate of Occurrence is:

Sample Size	.01%	.05%	.1%	.2%	.3%	.5%	1% [A]	2%
	The Probability of Including at Least One Occurrence in the Sample is:							
50		2%	5%	9%	14%	22%	39%	64%
60	1%	3	6	11	16	26	45	70
70	1	3	7	13	19	30	51	76
80	1	4	8	15	21	33	55	80
90	1	4	9	16	24	36	60	84
100	1	5	10	18	26	39	63	87
120	1	6	11	21	30	45	70	91
140	1	7	13	24	34	50	76	94
160	2	8	15	27	38	55	80	96
200	2	10	18	33	45	63	87	98
240	2	11	21	38	51	70	91	99
300	3	14	26	45	59	78	95	99+
340	3	16	29	49	64	82	97	99+
400	4	18	33	55	70	87	98	99+
460	5	21	37	60	75	90	99	99+
500	5	22	39	63	78	92	99	99+
600	6	26	45	70	84	95	99+	99+
700	7	30	50	75	88	97	99+	99+
800	8	33	55	80	91	98	99+	99+
900	9	36	59	83	93	99	99+	99+
1,000	10	39	63	86	95	99	99+	99+
1,500	14	53	78	95	99	99+	99+	99+
2,000	18	63	86	98	99+	99+	99+	99+
2,500	22	71	92	99	99+	99+	99+	99+
3,000	26	78	95	99+	99+	99+	99+	99+

Note: 99+ indicates a probability of 99.5% or greater. Probabilities in these tables are rounded to the nearest 1%. Differences in rounding techniques may cause a few entries in these tables to differ by one percentage point from comparable entries in other tables.

WORKSHEET 2

TABLE I-A

PROBABILITY IN PER CENT OF INCLUDING AT LEAST ONE OCCURRENCE IN A SAMPLE

FOR POPULATIONS OVER 10,000

If the True Population Rate of Occurrence is:

Sample Size	.01%	.05%	.1%	.2%	.3%	.5%	1% (A)	2%
	The Probability of Including at Least One Occurrence in the Sample is:							
50		2%	5%	9%	14%	22%	39%	64%
60	1%	3	6	11	16	26	45	70
70	1	3	7	13	19	30	51	76
80	1	4	8	15	21	33	55	80
90	1	4	9	16	24	36	60	84
100	1	5	10	18	26	39	63	87
120	1	6	11	21	30	45	70	91
140	1	7	13	24	34	50	76	94
160	2	8	15	27	38	55	80	96
200	2	10	18	33	45	63	87	98
240	2	11	21	38	51	70	91	99
(C) 300	3	14	26	45	59	78	(95) (B)	99+
340	3	16	29	49	64	82	97	99+
400	4	18	33	55	70	87	98	99+
460	5	21	37	60	75	90	99	99+
500	5	22	39	63	78	92	99	99+
600	6	26	45	70	84	95	99+	99+
700	7	30	50	75	88	97	99+	99+
800	8	33	55	80	91	98	99+	99+
900	9	36	59	83	93	99	99+	99+
1,000	10	39	63	86	95	99	99+	99+
1,500	14	53	78	95	99	99+	99+	99+
2,000	18	63	86	98	99+	99+	99+	99+
2,500	22	71	92	99	99+	99+	99+	99+
3,000	26	78	95	99+	99+	99+	99+	99+

Note: 99+ indicates a probability of 99.5% or greater. Probabilities in these tables are rounded to the nearest 1%. Differences in rounding techniques may cause a few entries in these tables to differ by one percentage point from comparable entries in other tables.

WORKSHEET 3

MODERN PRODUCERS

Modern Producers, a fast-growing electronics manufacturer, has approximately 2,000 hourly employees who are paid weekly by check from a payroll imprest fund. In addition to the testing of payroll transactions throughout the year, the auditor has decided to test the current payroll period. Because of the many additions to the work force since last year, he is concerned with the possibility of payroll padding as well as the less critical errors such as minor mistakes in overtime computations, incorrect payroll deductions, and the like. Names will be drawn from the payroll journal at random.

In this particular engagement, the auditor feels that he should be reasonably satisfied that payroll padding to the extent of ten or more ficticious or unauthorized employees at any one time would be detected by the system itself or by his examination.

Taking into consideration his other payroll testing procedures and his review of internal control procedures related to the payroll function, the auditor has decided to seek 90% assurance that the actual occurrence rate in the current payroll does not exceed 0.5% (10 ÷ 2000).

1. Population Size _____

2. Reliability _____

3. Maximum Occurrence Rate _____

4. Sample Size _____

5. Occurrences in Sample _____

WORKSHEET 4

SUBURBAN SUPPLY

In his test of the 12,000 receivable balances under $500.00 at Suburban Supply, the auditor elects to use attribute sampling to determine a maximum percentage of balances which might be in error. From his experience with the firm, he expects about 3% of the balances to contain errors and desires 95% assurance that the actual frequency of errors does not exceed 5%.

He also decides that, when evaluating his sample, he will keep separate note of any errors which might suggest misappropriation of funds or other irregularities. In this way, he can state with various degrees of confidence the probability that the actual occurrence rate of such deviations does not exceed .01%, 0.1%, and 0.5% respectively.

1. Specified Upper Limit (non-critical errors) _____
2. Estimated Occurrence Rate (non-critical errors) _____
3. Reliability _____
4. Sample Size _____
5. Non-critical errors in sample _____
6. Critical errors in sample _____
7. Upper Limit (non-critical errors) _____
8. Reliability of critical errors at 0.01% _____
9. Reliability of critical errors at 0.1% _____
10. Reliability of critical errors at 0.5% _____

WORKSHEET 5

PROBLEM: Given: $n = 160$
$p = .01$
N is over 10,000

Determine: P

where: n = sample size desired

p = specified true population rate of occurrence

P = probability of including at least one in sample

Q = 1 − P = probability of including 0 in sample

Formulae: $\log Q = n \log (1 - p)$

$P = 1 - Q$

Line	Item	Reference	Compute	Value
(A)	1 − p	Specified p	1.00 − p	
(B)	log (1 − p)	Log tables	log (A)	
(C)	n	Specified	--	
(D)	n log (1 − p)	--	(B) x (C)	
(E)	Q	Log tables	$\log^{-1}(D)$*	
(F)	P	1 − Q	1 − (E)	

*The notation, $\log^{-1}D$, indicates the real number for which the logarithm is D.

WORKSHEET 6

PROBLEM: Given: $n = 200$
$p = .01$
$N = 2{,}000$ to $5{,}000$

Determine: P

where:
- n = sample size desired
- p = specified true population rate of occurrence
- P = probability of including at least one in sample
- Q = probability of including 0 in sample
- N = population size
- K = number of population errors if actual error rate = p

Formulae: $\log Q = K \log \left(\frac{N - n}{N}\right)$

Line	Item	Reference	Compute	Value
(A)	N	Specified max.	--	
(B)	n	Specified		
(C)	$\frac{N - n}{N}$		$\frac{(A) - (B)}{A}$	
(D)	p	Specified		
(F)	K		(A) x (D)	
(F)	$\log \left(\frac{N - n}{N}\right)$	Log tables	log (C)	
(G)	$K \log \left(\frac{N - n}{N}\right)$		(E) x (F)	
(H)	Q	Log tables	$\log^{-1}$(G)	
(I)	P		1 − (H)	

SUMMARY OF VOLUME FOUR

Chapter I

1. Discovery sampling is a statistical procedure which permits the auditor to estimate the probability of including at least one example of a certain characteristic in his sample if the characteristic exists at some specified rate in the population. If, in fact, the sample does not reveal one such characteristic, then the auditor can state the probability that the characteristic does not exist at or above the specified occurrence rate.

2. Discovery sampling can be considered a special case of attribute sampling since the auditor's purpose is to measure the probability that the occurrence rate of a certain characteristic does not exceed some specified value. However, discovery sampling can be distinguished from attribute sampling in that the auditor's best initial estimate of the sample error rate is zero or close to zero.

3. The use of discovery sampling, rather than attribute sampling, permits the auditor to establish more precise values of the maximum tolerable occurrence rate.

4. In the definition of his sampling program, the auditor must first specify the population which he wishes to examine with discovery sampling. Then, by drawing the required sample from the population, he can draw certain conclusions about the population as a whole.

5. The statement of the problem must clearly define the particular characteristic under examination. In any given population, several different types of errors may exist. The impact of these upon the financial statements or the effectiveness of internal control may vary with the type of error. Further, the auditor may feel that the maximum tolerable occurrence rate of one type of error may be higher or lower than some other type. Therefore, he would probably find it advisable to evaluate each type of error separately.

6. In his problem definition, the auditor must specify the maximum tolerable occurrence rate for the characteristic under examination. This will be a function of the auditor's judgment of the

seriousness of the error and the materiality of the impact which errors at the maximum rate would have upon the statements.

7. The auditor must specify the confidence level (reliability) which he requires in his sampling program. No auditing program, short of 100% examination of all population items, will provide total assurance that any error does not occur in a population. As in the establishment of the maximum tolerable occurrence rate, the auditor's judgment will be guided by the relative seriousness and materiality of the error.

Chapter II

1. When the auditor has defined his population, the characteristic under examination, the maximum tolerable occurrence rate, and the desired reliability, he can determine his required sample size from the tables in Exhibit I.

2. Each of the three tables in Exhibit I corresponds to a different range of population size.

3. The auditor selects the table in Exhibit I corresponding to the size of his population. He enters the table by proceeding down the column corresponding to his maximum tolerable occurrence rate. When he has located his specified reliability, or the next higher value, he then identifies the row in which this value occurs. This row corresponds to his required sample size.

4. If population size and maximum occurrence rate are held constant and specified reliability increases, sample size will increase.

5. If specified reliability and maximum occurrence rate are held constant and population size increases, sample size will tend to increase.

6. If specified reliability and population size are held constant and maximum tolerable occurrence rate increases, sample size will decrease.

Chapter III

1. The auditor must select his sample using the random sampling procedure described in Volume I, An Introduction to Statistical Concepts and Estimation of Dollar Values, or the random

systematic sampling technique described in the appendix of Volume II, Sampling for Attributes.

2. When he examines the individual sample items, he must count only those occurrences which are defined in his problem statement for purposes of evaluation. If, in his examination, he uncovers other errors, he might then make note of these for separate evaluation.

3. If the auditor finds no errors in his sample, he can immediately conclude that the criteria of his sampling plan have been met. That is, he can state, with the specified confidence level, that the occurrence rate of the error in the population does not exceed the specified tolerable rate.

4. He can also make separate statements corresponding to each probability to the right of the sample size in the table. For the sample size selected, he can make several statements regarding the probability that the true occurrence rate does not exceed various values.

5. If the auditor does find one or more errors in his sample, he cannot use the discovery sampling tables for his evaluation. He must refer to the tables for attribute sampling which will permit him to measure the maximum occurrence rate based upon the number of errors he has found and his specified reliability.

Chapter IV

1. In many cases, an auditor may find the use of a combined sampling plan to be an efficient approach to examining a given population. Combined sampling plans are those in which the auditor simultaneously pursues an attribute sampling program and a discovery sampling program.

2. The statement of the attribute sampling plan will usually involve determination of the frequency of non-critical errors while the discovery sampling plan will usually involve critical errors.

3. The distinction between critical and non-critical errors in any given situation will be a function of the auditor's judgment. Typically, critical errors would be serious deviations from internal control procedures, evidence of irregularities, etc.

4. The auditor will usually determine his initial sample size based upon the requirements of the attribute sample. If, however, a specified reliability and maximum tolerable occurrence rate for the discovery sampling portion of his program require a larger sample size, he will select the larger sample.

5. As the auditor examines the population items, he will make separate note of critical errors and non-critical errors.

6. Using the tables for attribute sampling and the number of non-critical errors found, he will evaluate his attribute sample. If no critical errors are found, he can evaluate his discovery sample by referring to the sample size row in the appropriate table and determining the reliability that the true occurrence rate does not exceed the values in the specified columns.

7. If the combined sample does reveal one or more critical errors, he will have to use the tables for attribute sampling or some other technique to determine the maximum occurrence rate of critical errors.