



## Validation Report

# Calculator for Extrapolation of Net Weight in Conjunction with a Hypergeometric Sampling Plan

(Revised 2/4/2019)

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## 1. INTRODUCTION

Forensic laboratories performing seized drug analysis often receive submissions comprised of numerous similar containers (i.e. envelopes, bags, vials) each purportedly containing a controlled substance. Forensic analysis is performed usually in accordance with statutory mandates listing specific threshold weight values.

By viewing the totality of items in a submission as a population, compliance with statutory mandates becomes a matter of the proportion of the population containing a particular controlled substance, by weight. A conventional approach to determine this proportion is to weigh and chemically identify the contents of all individual containers necessary to reach a threshold amount. For submissions with a large number of containers, i.e., 30 or more, this approach becomes very time consuming and laborious. Alternately, analysts can take the following steps<sup>1</sup>:

1. weigh a sample of the population
2. calculate the average weight per unit
3. determine the proportion of the population that would need to be inferred to contain a controlled substance to meet or exceed a statutory weight threshold
4. use a hypergeometric sampling plan to calculate the number of units to analyze based on such inference
5. determine and report the weight and identity of the proportion of the population inferred to be positive.

SWGDRUG has developed an Excel based calculator to aid in the performance of weight estimations in conjunction with a hypergeometric sampling plan. This document validates the accuracy of the input and output parameters of the calculator.

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<sup>1</sup> See SWGDRUG Supplemental Document SD-6 for discussion on measurement uncertainty for extrapolations of net weight and unit count.

## 2. DEFINITIONS

Symbols	Equations	Description	Reference Cell(s)	SD-6 Reference
N		Population size; number of total units	K3:L3	A.1
n		Sample size; number of units weighed	D30:E30	A.2
		Sample size; theoretical number of units analyzed	S (hidden)	B.2
X		Net weight of each individual unit	B14:C28,E14:F28, H14:I28,K14:L28	A.3
$\bar{X}$	$\frac{x_1 + x_2 + x_3 \dots}{n}$	Average weight of the measured units using the arithmetic mean	D32:E32	A.4
s	$\sqrt{\frac{\sum (x - \bar{x})^2}{(n-1)}}$	Sample Standard Deviation a measure of how widely values are dispersed from the average value (the mean)	D34:E34	A.4
RSD	$S / \bar{X}$	Relative Standard Deviation ratio of the sample standard deviation (s) and the average weight ( $\bar{X}$ )	D36:E36	A.4
$u_w$		Standard uncertainty (unexpanded) associated with the balance	J10:L10	A.5
$u_{\bar{x}}$	$\frac{s}{\sqrt{n}}$	Standard uncertainty (unexpanded) of the calculated average weight ( $\bar{X}$ ). Uncertainty encompasses the standard deviation as well as the number of measurements performed. The square root of the sample size is used to account for the standard deviation.	D38:E38	A.6
$u_c$	$\sqrt{u_x^2 + u_w^2}$	Combined uncertainty for the average weight per unit considering the uncertainty contribution from the weighing equipment. The root-sum-squared method is used to combine the uncertainties.	D40:E40	A.7
W	$N * \bar{X}$	Extrapolated net weight; estimated total weight from the average weight ( $\bar{X}$ ) of the samples selected multiplied by the total numbers of samples (N)	K36:L36	A.8

Symbols	Equations	Description	Reference Cell(s)	SD-6 Reference
$u_t$	$N * u_c$	Extrapolated uncertainty (unexpanded) associated with the Extrapolated NW (W). This is obtained by multiplying the total number of samples (N) with the combined uncertainty ( $u_c$ ).	n/a	A.8
$\alpha$		Significance level; a predefined value that represents the risk of being “wrong” in reaching a conclusion. This probability is a suitably small number between 0 and 1.	n/a	B.2
CL	(1- $\alpha$ )	Confidence level; the predefined threshold value that represents the confidence in the conclusion. This probability corresponds to $\alpha$ resulting in a number between 0 and 1 (i.e. a 0.99 CL has an $\alpha$ of 0.01).	K30:L30 for weight extrapolations, D43:E43 for sampling	A.9 B.2
	(1- $P_n$ )	The hypergeometric distribution is used to calculate the CL (1- $P_n$ ) for incremental sample sizes (n, n+1, etc.) until it is equal to or greater than the desired CL (1- $\alpha$ ).	Q (hidden)	
	Overall	The level of confidence associated with combining the weight extrapolation and sampling inference (identity) calculated via the Bonferroni correction or multiplication rule.	A57:M57	B.6
P	$P_n = P_{sample\ 1} * P_{sample\ 2} * \dots * P_{sample\ n}$ $= \frac{(Samples\ that\ must\ be+) - 1}{N}$ $* \frac{(Samples\ that\ must\ be+) - 2}{N - 1} * \dots$ $* \frac{(Samples\ that\ must\ be+) - n}{N - (n - 1)}$	Probability of a specific event occurring for a specified sample size (n). As $P_n$ decreases, confidence level increases. A $P_n$ value of 0.01 is equal to a 0.99 CL. The hypergeometric distribution is used to calculate the minimum sample size that has to be analyzed by incrementally calculating the probability for each scenario until it is less than the threshold index for evaluation of confidence ( $\alpha$ ).	T (hidden)	B.2

Symbols	Equations	Description	Reference Cell(s)	SD-6 Reference
k		Coverage factor obtained from a two tailed Student's t-distribution with n-1 degrees of freedom. As n increases with more samples, k decreases for a given confidence level.	K32:L32	A.9
Lowest NW (sample)	$\bar{X} - (k * u_c)$	The lowest net weight estimated for a sample within a predefined confidence level. This is determined by subtracting the combined uncertainty for the average weight per unit ( $u_c$ ) from the average weight of the measured units ( $\bar{X}$ ).	D34:E34	B.1 (denominator)
$U_T$	$= k * u_t$ $= k * N * u_c$ $= k * N * \sqrt{u_x^2 + u_w^2}$	Expanded extrapolated uncertainty; expands the extrapolated uncertainty ( $u_c$ ) by the appropriate cover factor (k) to account for the desired confidence level in the uncertainty.	K38:L38	A.9
Lowest Extrapolated Net Weight	$W - U_T$	The lowest total net weight estimated for the total population within a predefined confidence level. This is determined by subtracting the expanded extrapolated uncertainty ( $U_T$ ) from the extrapolated NW (W).	K40:L40	A.10
Units inferred to be (+)	Statutory threshold weight / $\bar{X}$ (round up to the nearest integer)	The number of units inferred to contain a controlled substance in order to meet or exceed the threshold statutory weight. This becomes the population size (N) for reported net weight extrapolation.	K43:L43	B.1
>CL(1)/<CL(0)	GESTEP (Excel function)	Logical test to determine when the CL for incremental sample sizes is greater than the threshold value. The cell will return 1 when this condition is met.	R (hidden)	n/a
Units to be analyzed	VLOOKUP (Excel function)	The minimum number of units to be analyzed is determined by returning the integer of n relating to a confidence level equal to or greater than the threshold CL value.	K45:L45	B.2

Symbols	Equations	Description	Reference Cell(s)	SD-6 Reference
Reported NW	Units inferred to be (+) * $\bar{X}$ (truncate)	The total reported extrapolated net weight, in grams, of the units inferred to be positive. In SD-6, this value is truncated to same level of significance (decimal places) as the reported $U_T$ .	C49:D49	B.3
Reported $U_T$	$= (u_t * k)$ $= (n * uc * k)$ $= (n * \sqrt{u_x^2 + u_w^2} * k)$ (round)	Reported expanded extrapolated uncertainty associated with the Reported NW of the units inferred to be positive and needed to meet the minimum statutory requirement. In SD-6, this value is rounded up to 2 significant figures. It may be necessary to round to less significant figures if the rounded $U_T$ exceeds the readability of the balance.	C51:D51	B.4
Lower Limit Upper Limit	LL = (Reported NW) – (Reported $U_T$ ) UL = (Reported NW) + (Reported $U_T$ )	The reported NW range, in grams, at the specified level of confidence.	C53:D53,C55:D55	B.5
ozs.	Reported NW / 28.3495 LL / 28.3495 UL / 28.3495	Conversion of the reported NW, $U_T$ , lower limit (LL) and upper limit (UL), to ounces.	G49:H49,G51:H51 G53:H53,G55:H55	n/a
lbs.	LL / 28.3495 / 16 UL / 28.3495 / 16	Conversion of the reported NW, $U_T$ , lower limit (LL) and upper limit (UL), to pounds.	J49:K49,J51:K51 J53:K53,J55:K55	n/a

### **3. SOFTWARE**

The validation has been performed with Excel® 2013 and 2016 via comparison with the European Network of Forensic Science Institutes (ENFSI) Drug Working Group (DWG) Calculator for Qualitative Sampling of Seized Drugs, version July 2017.

### **4. VALIDATION**

The spreadsheet demonstrates the calculations in Examples 1 and 2 of SD-6 "Measurement Uncertainty for Extrapolations of Net Weight and Unit Count". It is designed to fit the vast majority of seized drug submissions allowing for use with multi-unit populations of 5000 or less and an input of 60 or less net weights.

For easier handling of the calculator, mandatory entry cells are highlighted yellow with the exception of the net weight entry fields. Formula cells are password protected to prohibit inadvertent changes to the spreadsheet. Additionally, data validation will alert the user when invalid entries are input in the population size, weight, uncertainty and confidence level cells. Lastly, the net weight entry cells are conditionally formatted to display the number of decimal places (0 to 6) corresponding to the balance readability (1 g to 0.001 mg).

The worksheet is divided into 3 sections:

- Estimation of Weight (SD-6 Example 1)
- Hypergeometric Sampling (SD-6 Example 2 B.1 to B.2)
- Reported Weight Extrapolation (SD-6 Example 3 B.3 to B.6)

Five datasets of various weights and population sizes were put into the calculator. The final output for each section was compared with the validated ENFSI calculator. See Appendix A for raw data entries and the corresponding ENFSI results in green.



#### 4.1. Estimation of Weight

The first section of the calculator is titled "Extrapolation of Net Weight (NW)" and calculates the estimated net weight for the entire population based on the weight of a subset of units.

Scientific Working Group for the Analysis of Seized Drugs							
<u>Case #:</u>		<u>Population Size (N):</u> <input type="text"/>					
<u>Unit #:</u>		<u>Balance ID:</u> <input type="text"/>		<u>Total Gross Weight (g):</u> <input type="text"/>			
<u>Analyst:</u>							
Extrapolation of Net Weight (NW)							
<u>Balance Readability:</u> <input type="text"/>				<u>u<sub>w</sub> (unexpanded):</u> <input type="text"/>			
<u>Unit:</u>	<u>Net Weight (g):</u>	<u>Unit:</u>	<u>Net Weight (g):</u>	<u>Unit:</u>	<u>Net Weight (g):</u>	<u>Unit:</u>	<u>Net Weight (g):</u>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<u>Sample Size (n)</u>	<input type="text" value="0"/>	<u>Average NW (<math>\bar{X}</math>)</u>		<input type="text" value="#DIV/0!"/>	grams	<u>Confidence Level (1-<math>\alpha</math>)</u>	<input type="text"/>
<u>Std. Dev. (s)</u>	<input type="text" value="#DIV/0!"/>	<u>Student-t (k)</u>		<input type="text" value="#NUM!"/>		<u>Lowest NW (sample)</u>	<input type="text" value="#DIV/0!"/>
<u>RSD</u>	<input type="text" value="#DIV/0!"/>	<u>Extrapolated NW (W)</u>		<input type="text" value="#DIV/0!"/>	grams	<u>U<sub>T</sub></u>	<input type="text" value="#NUM!"/>
<u>u<math>\bar{x}</math></u>	<input type="text" value="#DIV/0!"/>	<u>Lowest Extrapolated NW</u>		<input type="text" value="#DIV/0!"/>	grams		
<u>u<sub>c</sub></u>	<input type="text" value="#DIV/0!"/>						

The parameters in this section are calculated using the following Excel formulas:

Sample size (n) =COUNT(B14:C28,E14:F28,H14:I28,K14:L28)

Average NW ( $\bar{X}$ ) =AVERAGE(B14:C28,E14:F28,H14:I28,K14:L28)

Standard deviation (s) =STDEV.S(B14:C28,E14:F28,H14:I28,K14:L28)

RSD =D34/D32 cell is formatted a percentage

Standard uncertainty of the average NW (u $\bar{x}$ ) =D34/SQRT(D30)

Combined uncertainty of  $\bar{X}$  and balance (u<sub>c</sub>) =SQRT(SUMSQ(D38,J10))

$$\text{Student-t (k)} = T.INV.2T((1-K30), D30-1)$$

$$\text{Lowest NW (sample)} = D32 - (K32 * D40)$$

$$\text{Extrapolated NW (W)} = D32 * K3$$

$$\text{Expanded combined uncertainty (U}_T) = K3 * K32 * \text{SQRT}(\text{SUMSQ}(D38, J10))$$

$$\text{Lowest Extrapolated NW} = K36 - K38$$

The extrapolated net weight (W) and associated expanded combined uncertainty (U<sub>T</sub>) was compared with the ENFSI estimations for each dataset. It should be noted that the ENFSI calculator applies a finite correction factor, Q<sub>corr</sub>, if n/N > 0.1 which lessens the total uncertainty. Thus, the SWGDRUG calculator results in more conservative uncertainties for Datasets 2, 4 and 5. Because the terminal output is in agreement, Excel formulas are valid and correct for this section of the calculator.

#### 4.2. Hypergeometric Sampling

The second section of the calculator is titled "Hypergeometric Sampling" and uses the NW estimation from the first section to determine the number of units that *must be demonstrated (inferred) to contain a controlled substance* in order to meet a minimum statutory weight. Subsequently, this section statistically determines the minimum number of units that *must be analyzed* to allow such an inference, that the amount of material containing a controlled substance is enough to exceed the statutory weight.

<b>Hypergeometric Sampling</b>			
Confidence Level (1-α)	<input type="text"/>	Units inferred to be (+)	<input type="text" value="#DIV/0!"/>
Minimum Statutory Wt.	<input type="text"/> grams	Units to be analyzed	<input type="text" value="#N/A"/>

The parameters in this section are calculated using the following Excel formulas:

$$\text{Units inferred to be (+)} = \text{ROUNDUP}(D45/K34, 0)$$

$$\text{Units to be analyzed} = \text{VLOOKUP}(1, R4:S1044, 2, \text{FALSE})$$

$$\text{*Theoretical number of items tested (n)} = \text{IF}(\$K\$3 - (\$K\$3 - 1) < \$K\$3, \$K\$3 - (\$K\$3 - 1), \$K\$3) ; = \text{IF}(\$K\$3 - (\$K\$3 - 1 - S\#) < \$K\$3, \$K\$3 - (\$K\$3 - 1 - S\#), \$K\$3)$$

$$\text{*Probability that fewer than the 'Units inferred to be (+)'} \text{ exists given various theoretical sample sizes (P)} = \text{HYPGEOM.DIST}(S\#, S\#, \$K\$43 - 1, \$K\$3, \text{FALSE})$$

\*Level of confidence that at least the 'Units inferred to be (+)' exists given various theoretical sample sizes (CL) =1-HYPGEOM.DIST(S#,S#,\$K\$43-1,\$K\$3,FALSE)

\*Logical test that returns 0 when the theoretical confidence level is less than the threshold confidence level and 1 when it is met or exceeded (>CL(1)/<CL(0))

=GESTEP(Q#,\$D\$43)

*\*indicated hidden column*

*"#" denotes incremental row number(s)*

The number of samples that must be analyzed agrees with the ENFSI estimations for each dataset. Because this terminal output has been verified, Excel formulas are valid and correct for this section of the calculator.

### 4.3. Reported Weight Extrapolation

The third section of the calculator is titled "Reported Weight Extrapolation" and produces the reported NW and uncertainty resulting from the hypergeometric sampling procedure and using the average net weight per unit determined in the first section.

<b>Reported Weight Extrapolation</b>			
<b>Reported NW</b>	<input type="text" value="#DIV/0!"/> grams	<input type="text" value="#DIV/0!"/> ozs.	<input type="text" value="#DIV/0!"/> lbs.
<b>Reported U<sub>T</sub></b>	<input type="text" value="#DIV/0!"/> grams	<input type="text" value="#DIV/0!"/> ozs.	<input type="text" value="#DIV/0!"/> lbs.
<b>Lower Limit</b>	<input type="text" value="#DIV/0!"/> grams	<input type="text" value="#DIV/0!"/> ozs.	<input type="text" value="#DIV/0!"/> lbs.
<b>Upper Limit</b>	<input type="text" value="#DIV/0!"/> grams	<input type="text" value="#DIV/0!"/> ozs.	<input type="text" value="#DIV/0!"/> lbs.
<b>The overall level of confidence for weight and identity is at least 0%.</b>			

The parameters in this section are calculated by the following Excel formulas:

Reported NW =K43\*D32 grams; =C49/28.3495 ounces; =C49/28.3495/16 pounds

Reported U<sub>T</sub> =K43\*K32\*SQRT(SUMSQ(D38,J10)) grams; =C51/28.3495 ounces; =C51/28.3495/16 pounds

Lower Limit =C49-C51 grams; =C53/28.3495 ounces; =C53/28.3495/16 pounds

Upper Limit =C49+C51 grams; =C55/28.3495 ounces; =C55/28.3495/16 pounds

The reported net weight (NW) and associated uncertainty ( $U_T$ ) was compared to the ENFSI estimations for each dataset. It should be noted that the ENFSI calculator applies a finite correction factor,  $Q_{corr}$ , if  $n/N > 0.1$  which decreases the total uncertainty. Thus, the SWGDRUG calculator results in a more conservative uncertainty for Dataset 2. For Reported Weight Extrapolations, the sample size ( $n$ ) is considered the number of units weighed and the population ( $N$ ) is adjusted to the number of units inferred to be positive as denoted with an asterisk (\*) for each dataset in Appendix A. The ENFSI calculator is unable to calculate the uncertainty associated with Datasets 4 and 5 due to  $n$  exceeding  $N$ . The  $Q_{corr}$  returns a negative value for Dataset 4 ( $N = 6$  and  $n = 40$ ) and 5 ( $N = 21$  and  $n = 45$ ). Thus, comparison to ENFSI is not possible. These values were calculated by hand to be 2.50 and 136 for Datasets 4 and 5 respectively. Because this terminal output is in agreement, Excel formulas are valid and correct for this section of the calculator.

## **5. CONCLUSION**

The SWGDRUG Calculator for Extrapolation of Net Weight in Conjunction with a Hypergeometric Sampling Plan version 1.0 is valid and fit for purpose.

## **6. CONTACT**

Please address questions, report errors and/or bugs found in the Excel software or within this document to [swgdrug@hotmail.com](mailto:swgdrug@hotmail.com).

## 7. APPENDIX A

<b>Scientific Working Group for the Analysis of Seized Drugs</b>							
<b>Case #:</b> Dataset 1		<b>Population Size (N):</b> 500					
<b>Unit #:</b> 1-500		<b>Balance ID:</b>		<b>Total Gross Weight (g):</b>			
<b>Analyst:</b> MB		B509638893		170.42			
<b>Extrapolation of Net Weight (NW)</b>							
<b>Balance Readability:</b>				<b>u<sub>w</sub> (unexpanded):</b>			
0.1 mg				0.003100537			
<b>Unit:</b>	<b>Net Weight (g):</b>	<b>Unit:</b>	<b>Net Weight (g):</b>	<b>Unit:</b>	<b>Net Weight (g):</b>	<b>Unit:</b>	<b>Net Weight (g):</b>
1	0.0490	16	0.0433				
2	0.0333	17	0.0543				
3	0.0394	18	0.0455				
4	0.0499	19	0.0400				
5	0.0466	20	0.0534				
6	0.0385	21	0.0424				
7	0.0553	22	0.0534				
8	0.0468	23	0.0448				
9	0.0475	24	0.0503				
10	0.0693	25	0.0409				
11	0.0511	26	0.0467				
12	0.0415	27	0.0341				
13	0.0445	28	0.0494				
14	0.0492	29	0.0469				
15	0.0512	30	0.0421				
<b>Sample Size (n)</b>	30		<b>Confidence Level (1-α)</b>	0.99			
<b>Average NW (<math>\bar{X}</math>)</b>	0.046686667		grams	<b>Student-t (k)</b>	2.756385904		
<b>Std. Dev. (s)</b>	0.007046923		grams	<b>Lowest NW (sample)</b>	0.037433814		
<b>RSD</b>	15.1%			<b>Extrapolated NW (W)</b>	23.34333333		
<b>u<math>\bar{x}</math></b>	0.001286586		grams	<b>U<math>\bar{r}</math></b>	4.62642642		
<b>u<sub>c</sub></b>	0.003356879		grams	<b>Lowest Extrapolated NW</b>	18.71690691		
					23.343		
					4.626		
<b>Hypergeometric Sampling</b>							
<b>Confidence Level (1-α)</b>	0.99		<b>Units inferred to be (+)</b>	401			
<b>Minimum Statutory Wt.</b>	15		grams	<b>Units to be analyzed</b>	21		
					21		
<b>Reported Weight Extrapolation</b> *Adjusted N = Units inferred to be (+) = 401 and n = Sample Size = 30							
<b>Reported NW</b>	18.72135333	grams	0.660376844	ozs.	0.041273553	lbs.	
	18.721*						
<b>Reported U<math>\bar{r}</math></b>	3.710393989	grams	0.130880403	ozs.	0.008180025	lbs.	
	3.710*						
<b>Lower Limit</b>	15.01095934	grams	0.529496441	ozs.	0.033093528	lbs.	
<b>Upper Limit</b>	22.43174732	grams	0.791257247	ozs.	0.049453578	lbs.	
<b>The overall level of confidence for weight and identity is at least 98.01%.</b>							

## Scientific Working Group for the Analysis of Seized Drugs

**Case #:** Dataset 2

**Population Size (N):** 50

**Unit #:** 1-50

**Analyst:** TR

**Balance ID:**

B746999853

**Total Gross Weight (g):**

170.42

### Extrapolation of Net Weight (NW)

**Balance Readability:**

0.001 g

**u<sub>w</sub> (unexpanded):**

0.001496364

Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):
1	0.490	16	0.433				
2	0.333	17	0.543				
3	0.394	18	0.455				
4	0.499	19	0.400				
5	0.466	20	0.534				
6	0.385	21	0.424				
7	0.553	22	0.534				
8	0.468	23	0.448				
9	0.475	24	0.503				
10	0.693	25	0.409				
11	0.511	26	0.467				
12	0.415	27	0.341				
13	0.445	28	0.494				
14	0.492	29	0.469				
15	0.512	30	0.421				

**Sample Size (n)**

30

**Confidence Level (1-α)**

0.99

**Average NW ( $\bar{X}$ )**

0.466866667 grams

**Student-t (k)**

2.756385904

**Std. Dev. (s)**

0.070469232 grams

**Lowest NW (sample)**

0.431164337 grams

**RSD**

15.1%

**Extrapolated NW (W)**

23.34333333 grams

**u<sub>x̄</sub>**

0.012865863 grams

**U<sub>T</sub>**

1.7851165 grams

**u<sub>c</sub>**

0.012952588 grams

**Lowest Extrapolated NW**

21.55821683 grams

### Hypergeometric Sampling

**Confidence Level (1-α)**

0.99

**Units inferred to be (+)**

35

**Minimum Statutory Wt.**

15 grams

**Units to be analyzed**

11

### Reported Weight Extrapolation

\*Adjusted N = Units inferred to be (+) = 35 and n = Sample Size = 30

**Reported NW**

16.34033333 grams

0.576388766 ozs.

0.036024298 lbs.

16.340\*

**Reported U<sub>T</sub>**

1.24958155 grams

0.044077728 ozs.

0.002754858 lbs.

0.472\*

**Lower Limit**

15.09075178 grams

0.532311038 ozs.

0.03326944 lbs.

**Upper Limit**

17.58991488 grams

0.620466494 ozs.

0.038779156 lbs.

**The overall level of confidence for weight and identity is at least 98.01%.**

## Scientific Working Group for the Analysis of Seized Drugs

**Case #:** Dataset 3

**Population Size (N):** 1512

**Unit #:** 1-1512

**Analyst:** MB

**Balance ID:**

6656

**Total Gross Weight (g):**

448.65

### Extrapolation of Net Weight (NW)

**Balance Readability:**

0.1 mg

**u<sub>w</sub> (unexpanded):**

0.003100537

Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):
1	0.0387	16	0.0418	31	0.0310	46	0.0257
2	0.0278	17	0.0266	32	0.0237	47	0.0242
3	0.0191	18	0.0248	33	0.0472	48	0.0282
4	0.0267	19	0.0412	34	0.0275	49	0.0237
5	0.0511	20	0.0190	35	0.0320	50	0.0331
6	0.0227	21	0.0275	36	0.0244	51	0.0243
7	0.0391	22	0.0378	37	0.0387	52	0.0276
8	0.0303	23	0.0209	38	0.0366	53	0.0295
9	0.0239	24	0.0272	39	0.0249	54	0.033
10	0.0223	25	0.0415	40	0.0227	55	0.0273
11	0.0241	26	0.0327	41	0.0323	56	0.025
12	0.0314	27	0.0291	42	0.0277	57	0.0292
13	0.0283	28	0.0552	43	0.0340	58	0.0278
14	0.0304	29	0.0260	44	0.0257	59	0.0498
15	0.0334	30	0.0273	45	0.0320	60	0.0358

**Sample Size (n)**

60

**Confidence Level (1-α)**

0.95

**Average NW ( $\bar{X}$ )**

0.030541667 grams

**Student-t (k)**

2.000995378

**Std. Dev. (s)**

0.007750326 grams

**Lowest NW (sample)**

0.024022457 grams

**RSD**

25.4%

**Extrapolated NW (W)**

46.179 grams

**u<sub>x̄</sub>**

0.001000563 grams

**U<sub>T</sub>**

9.85704501 grams

**u<sub>c</sub>**

0.003257983 grams

**Lowest Extrapolated NW**

36.32195499 grams

### Hypergeometric Sampling

**Confidence Level (1-α)**

0.95

**Units inferred to be (+)**

625

**Minimum Statutory Wt.**

15 grams

**Units to be analyzed**

4

### Reported Weight Extrapolation

\*Adjusted N = Units inferred to be (+) = 625 and n = Sample Size = 60

<b>Reported NW</b>	19.08854167 grams	0.673329042 ozs.	0.042083065 lbs.
	19.089*		
<b>Reported U<sub>T</sub></b>	4.074506039 grams	0.143724088 ozs.	0.008982756 lbs.
	4.075*		
<b>Lower Limit</b>	15.01403563 grams	0.529604953 ozs.	0.03310031 lbs.
<b>Upper Limit</b>	23.16304771 grams	0.81705313 ozs.	0.051065821 lbs.

The overall level of confidence for weight and identity is at least 90.25%.



## Scientific Working Group for the Analysis of Seized Drugs

**Case #:** Dataset 4

**Population Size (N):** 151

**Unit #:** 1-151

**Analyst:** TR

**Balance ID:**

24AP8

**Total Gross Weight (g):**

479.81

### Extrapolation of Net Weight (NW)

**Balance Readability:**

0.01 g

**$u_w$  (unexpanded):**

0.073617359

Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):
1	3.87	16	4.18	31	3.10		
2	2.78	17	2.66	32	2.37		
3	1.91	18	2.48	33	4.72		
4	2.67	19	4.12	34	2.75		
5	5.11	20	1.90	35	3.20		
6	2.27	21	2.75	36	2.44		
7	3.91	22	3.78	37	3.87		
8	3.03	23	2.09	38	3.66		
9	2.39	24	2.72	39	2.49		
10	2.23	25	4.15	40	2.27		
11	2.41	26	3.27				
12	3.14	27	2.91				
13	2.83	28	5.52				
14	3.04	29	2.60				
15	3.34	30	2.73				

**Sample Size (n)** 40

**Confidence Level (1- $\alpha$ )** 0.99

**Average NW ( $\bar{X}$ )** 3.0915 grams

**Student-t (k)** 2.707913184

**Std. Dev. (s)** 0.856859352 grams

**Lowest NW (sample)** 2.673965477 grams

**RSD** 27.7%

**Extrapolated NW (W)** 466.8165 grams

**$u_{\bar{x}}$**  0.135481359 grams

**$U_T$**  63.04771292 grams

**$u_c$**  0.154190513 grams

**Lowest Extrapolated NW** 403.7687871 grams

466.817

54.056

### Hypergeometric Sampling

**Confidence Level (1- $\alpha$ )** 0.99

**Units inferred to be (+)** 6

**Minimum Statutory Wt.** 15 grams

**Units to be analyzed** 2

2

### Reported Weight Extrapolation

\*Adjusted N = Units inferred to be (+) = 6 and n = Sample Size = 40

## Scientific Working Group for the Analysis of Seized Drugs

**Case #:** Dataset 5

**Population Size (N):** 160

**Unit #:** 1.1-1.160

**Analyst:** MB

**Balance ID:**

E8002S

**Total Gross Weight (g):**

82464

### Extrapolation of Net Weight (NW)

**Balance Readability:**

1 g

**$u_w$  (unexpanded):**

0.839052045

Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):	Unit:	Net Weight (g):
1.1	498	1.16	497	1.31	493		
1.2	502	1.17	503	1.32	496		
1.3	505	1.18	504	1.33	505		
1.4	497	1.19	499	1.34	502		
1.5	508	1.20	509	1.35	498		
1.6	501	1.21	500	1.36	507		
1.7	500	1.22	499	1.37	510		
1.8	497	1.23	498	1.38	494		
1.9	496	1.24	495	1.39	503		
1.10	494	1.25	496	1.40	500		
1.11	502	1.26	503	1.41	499		
1.12	503	1.27	506	1.42	499		
1.13	500	1.28	500	1.43	502		
1.14	507	1.29	502	1.44	497		
1.15	505	1.30	598	1.45	498		

**Sample Size (n)**

45

**Confidence Level (1- $\alpha$ )**

0.99

**Average NW ( $\bar{X}$ )**

502.8222222 grams

**Student-t (k)**

2.692278266

**Std. Dev. (s)**

15.09257627 grams

**Lowest NW (sample)**

496.3574368 grams

**RSD**

3.0%

**Extrapolated NW (W)**

80451.55556 grams

**$u_{\bar{x}}$**

2.249868434 grams

**$U_T$**

1034.365662 grams

**$u_c$**

2.401232247 grams

**Lowest Extrapolated NW**

79417.18989 grams

80451.556

876.926

### Hypergeometric Sampling

**Confidence Level (1- $\alpha$ )**

0.99

**Units inferred to be (+)**

21

**Minimum Statutory Wt.**

10000 grams

**Units to be analyzed**

3

3

### Reported Weight Extrapolation

\*Adjusted N = Units inferred to be (+) = 21 and n = Sample Size = 45

**Reported NW**

10559.26667 grams

372.4674744 ozs.

23.27921715 lbs.

10559.267\*

**Reported  $U_T$**

135.7604932 grams

4.788814376 ozs.

0.299300899 lbs.

N/A\*

**Lower Limit**

10423.50617 grams

367.6786601 ozs.

22.97991625 lbs.

**Upper Limit**

10695.02716 grams

377.2562888 ozs.

23.57851805 lbs.

**The overall level of confidence for weight and identity is at least 98.01%.**