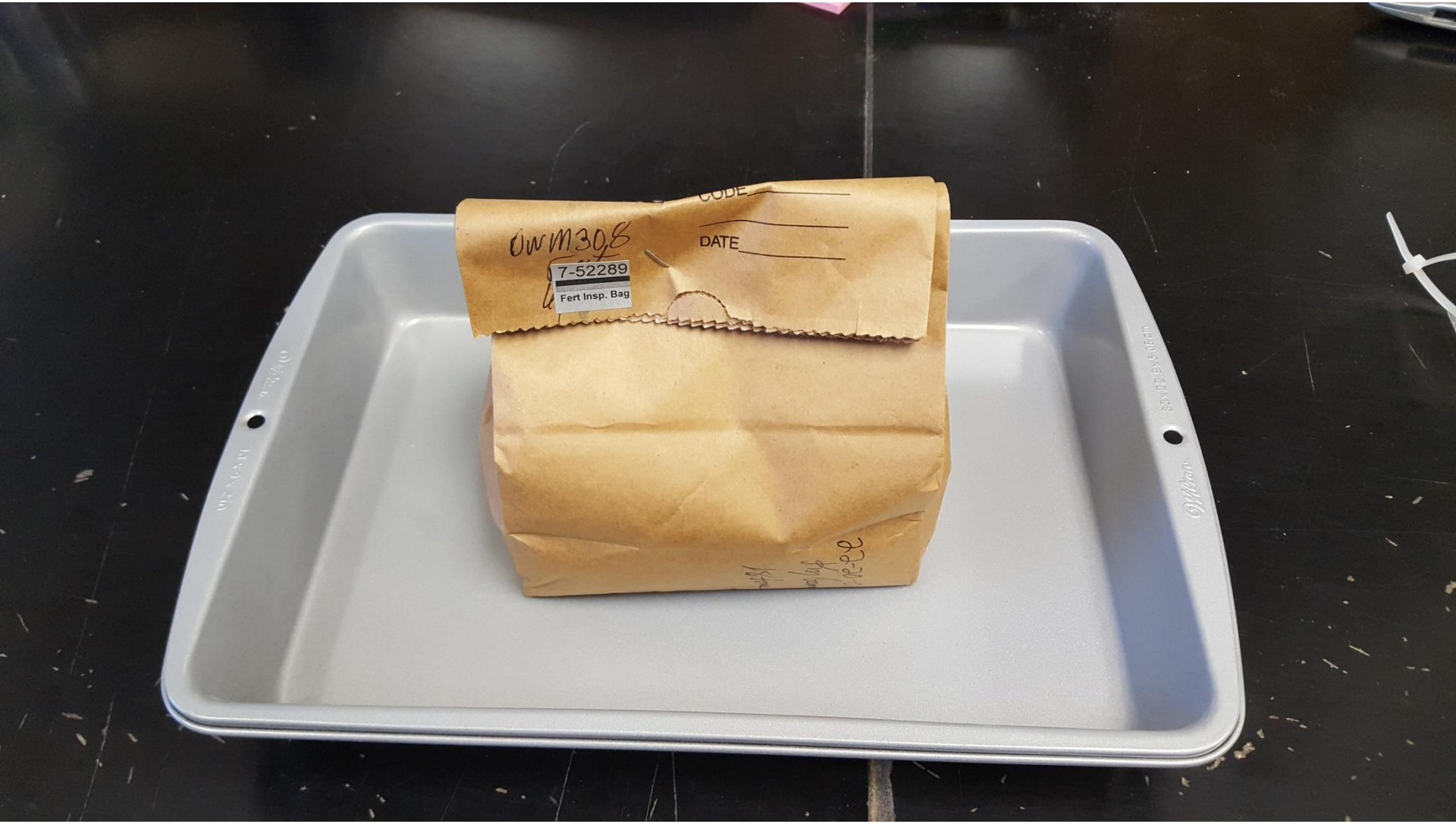
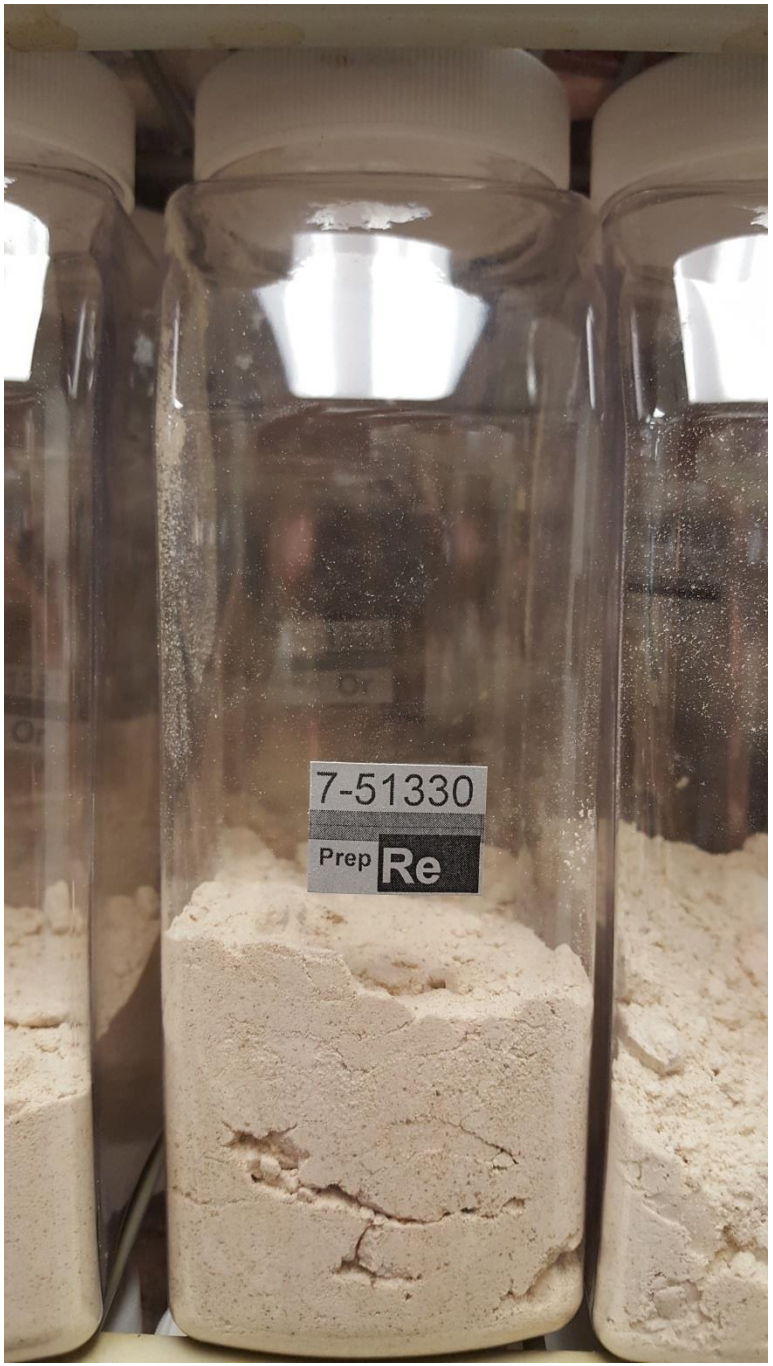
Uncertainity in Lab Results

- Individual Lab
- Multiple Labs

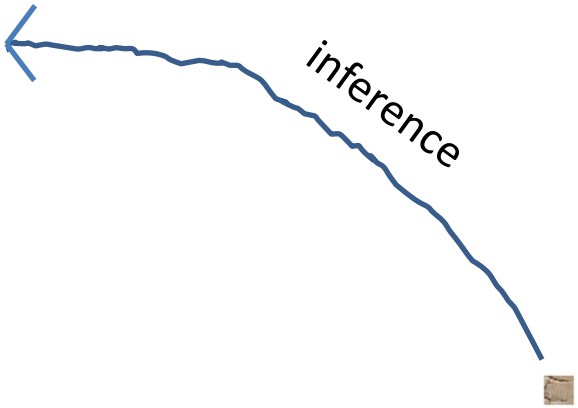
The Lab's Sample Unit




7-51330
Prep
Re


LECO
ON736

Decision Unit

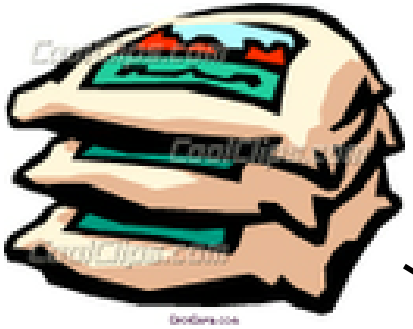


Inference

Inference: Using your observations to make a best guess about an object based on sound reasoning.

No inference required

Decision Unit



10 % N

Decision Unit

S^2_{samp}

S^2_{prep}

S^2_{lab}

S^2_{instr}

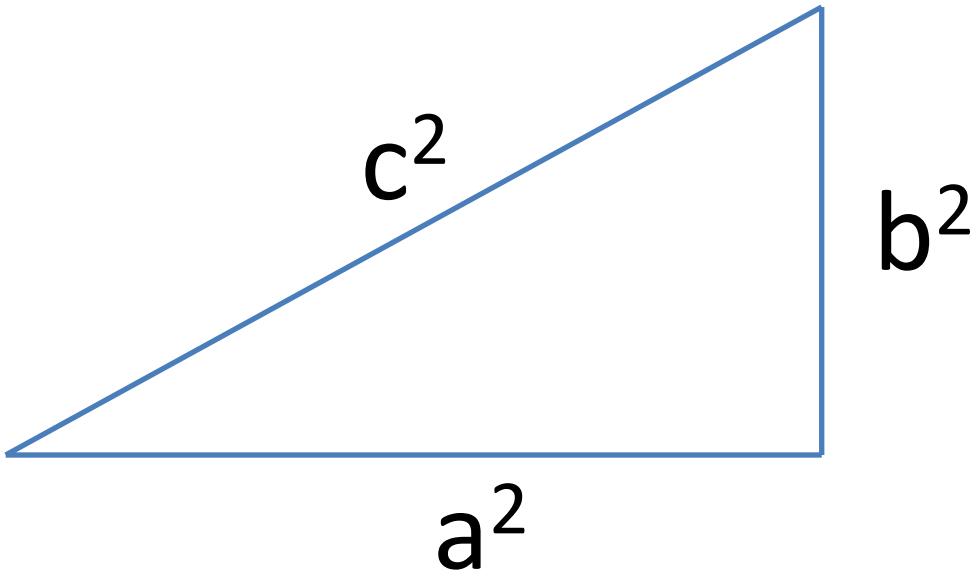
inference required

95% probability that N is between 8 and 10%

$$S^2_{total} = S^2_{samp} + S^2_{prep} + S^2_{lab} + S^2_{instr}$$

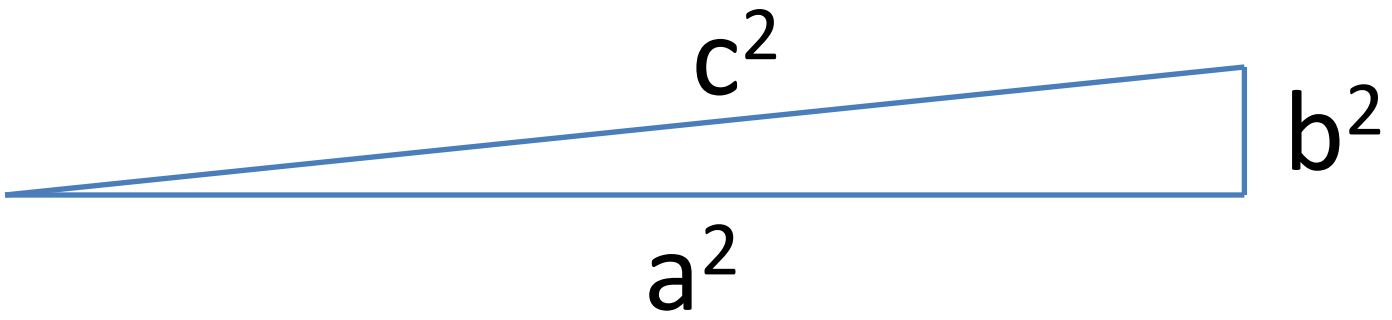
$$RSD^2_{Total} = RSD^2_{samp} + RSD^2_{prep} + RSD^2_{lab} + RSD^2_{instr}$$

Pythagorean Theorem



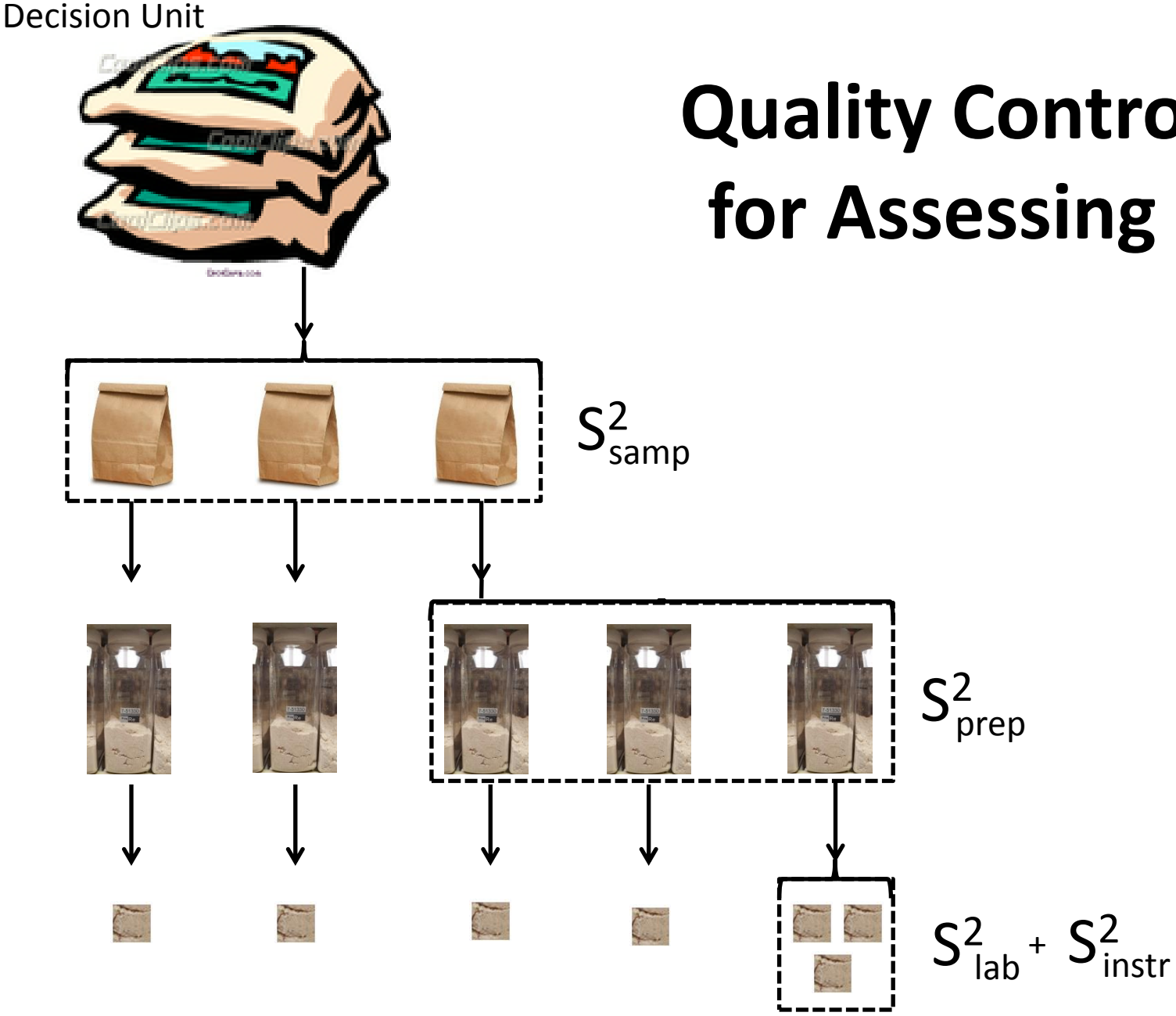
$$a^2 + b^2 = c^2$$

Weakest link controls overall error



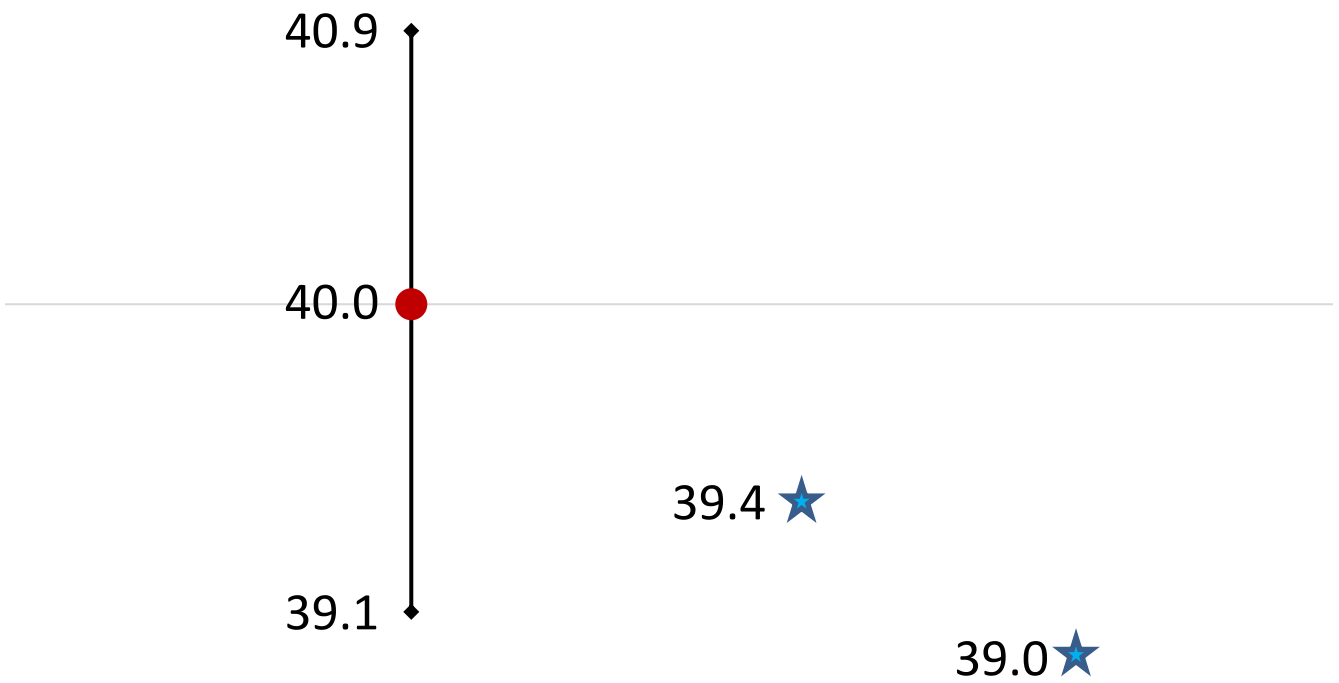
$$a^2 + b^2 = c^2$$

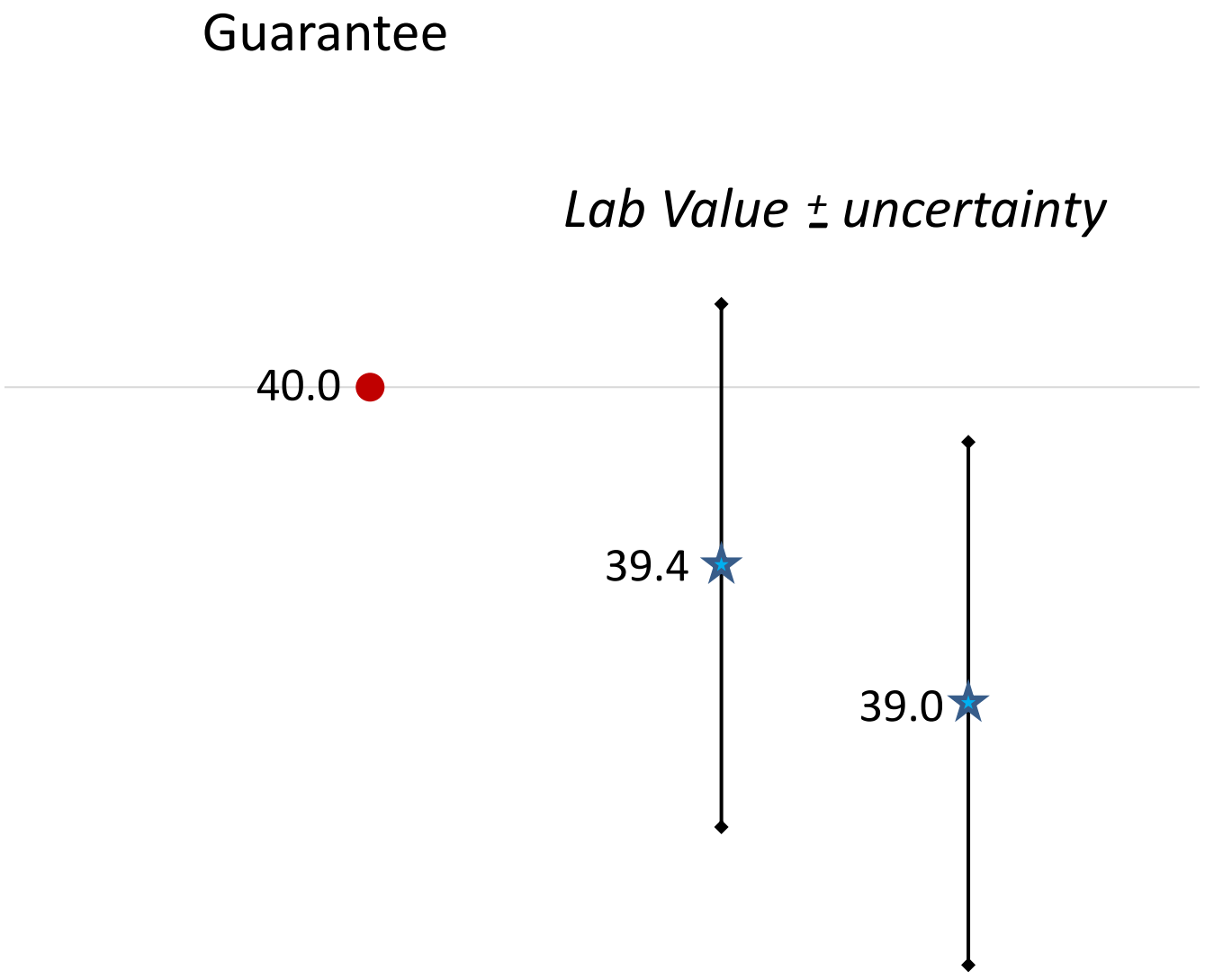
Quality Control Plan for Assessing Error



Multiple Labs and Investigational Allowance

Guarantee ± Investigational Allowance




Guarantee
Lab Value ± uncertainty
40.0
39.4
39.0

Decision Unit

S^2_{samp}

$S^2_{interlab}$

S^2_{prep}

S^2_{lab}

S^2_{instr}

Sample Collection

Entered into eLab

Verified by Supervisor and given to Director

Ready for Lab

Lab Tests complete

Director prints or emails report

Decision Unit

$S^2_{sampling}$

Laboratory Sample

S^2_{prep}

Test Sample

S^2_{lab}

Test Portion

$S^2_{analytical}$

$$S^2_{total} = S^2_{samp} + S^2_{interlab} + S^2_{prep} + S^2_{lab} + S^2_{instr}$$

$$RSD^2_{Total} = RSD^2_{samp} + RSD^2_{interlab} + RSD^2_{prep} + RSD^2_{lab} + RSD^2_{instr}$$

Appropriate Investigational Allowance

$$RSD_{Total} = \sqrt{RSD^2_{samp} + RSD^2_{interlab} + RSD^2_{prep} + RSD^2_{lab} + RSD^2_{instr}}$$

$$\text{Investigational Allowance} = RSD_{Total} \times 2$$

Using just Proficiency Data

$$RSD_{Total} = \sqrt{RSD^2_{samp} + RSD^2_{interlab} + RSD^2_{rep} + RSD^2_{lab} + RSD^2_{instr}}$$

Investigational Allowance = RSD_{Total} x 2

THE BACKGROUND AND RATIONALE FOR AAPFCO

Recommended Investigational Allowances[1]

Robert C. Rund
Indiana

The concept of what is now known as "Investigational Allowances" has generally undergone some change during the 27 years that the Association of American Plant Food Control Officials has been in existence. In the beginning philosophies ranged from the belief that a laboratory result found below the guarantee, by whatever magnitude, was sufficient reason to declare a sample deficient, to the practice of applying an arbitrary set of "tolerances" when and if the administrator so desired. To support this contention I quote from the Presidential Address of D.S. Coltran (1) to the Association of American Fertilizer Control Officials in 1947, "The tolerance as set forth in the law tells you just when to penalize. Some who do not have tolerances in your laws have them in your mind or your desk drawer."

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[1] Reprinted from: AAPFCO Official Publication No. 28 (1975), Pgs. 67-75

Table 3

Buildup of Components of Variance Affecting Potash Analyses

%Guarantee	----------Variances----------				Standard Deviation	Investigational Allowance[5]
	Sampling[1]	Reduction and Intralab[2]	Interlab[3]	Sum		
5	0.005443	0.029061	0.000000	0.034504	0.185752	0.43
10	0.013046	0.040908	0.035743	0.089698	0.299495	0.7
15	0.023922	0.052756	0.074184	0.150862	0.388409	0.9
20	0.038069	0.064603	0.112626	0.215298	0.464002	1.08
25	0.055488	0.076451	0.151063	0.283007	0.531984	1.24
30	0.076178	0.088299	0.189510	0.353987	0.594968	1.39

Another Yardstick

- Consensus Reports

magruder fertilizer
check sample program

STRIVING FOR EXCELLENCE IN ANALYSIS

Consensus Report

A Quality Reference Material

Magruder Check Sample # 160111

Micro Mix

Analyte	Value	± Uncertainty	# Labs
Soluble Potassium as K2O (%)	0.177	2.05E-02	7
Acid Soluble Calcium (%)	2.263	4.42E-02	11
Acid Soluble Magnesium (%)	0.6692	2.55E-02	12
Total Sulfur (%)	0.201	4.58E-02	7
Acid Soluble Boron (1.5%)	1.547	1.53E-02	51
Acid Soluble Cadmium (ppm)	4.473	3.34E-01	7
Acid Soluble Chromium (ppm)	73.96	7.01E+00	7
Acid Soluble Cobalt (ppm)	155.4	1.28E+01	6
Acid Soluble Copper (3%)	3.942	3.37E-02	66
Acid Soluble Iron (18%)	18.41	2.17E-01	65
Acid Soluble Lead (ppm)	469.3	1.31E+01	6
Acid Soluble Manganese (7.5%)	8.249	7.37E-02	61
Acid Soluble Molybdenum (200ppm)	195.2	1.32E+01	24
Acid Soluble Nickel (ppm)	114.4	1.04E+01	6
Sodium (%)	0.5633	1.09E-02	7
Acid Soluble Zinc (7%)	8.163	6.53E-02	67

Standard Deviation (sdev) & Standard Error (serr)

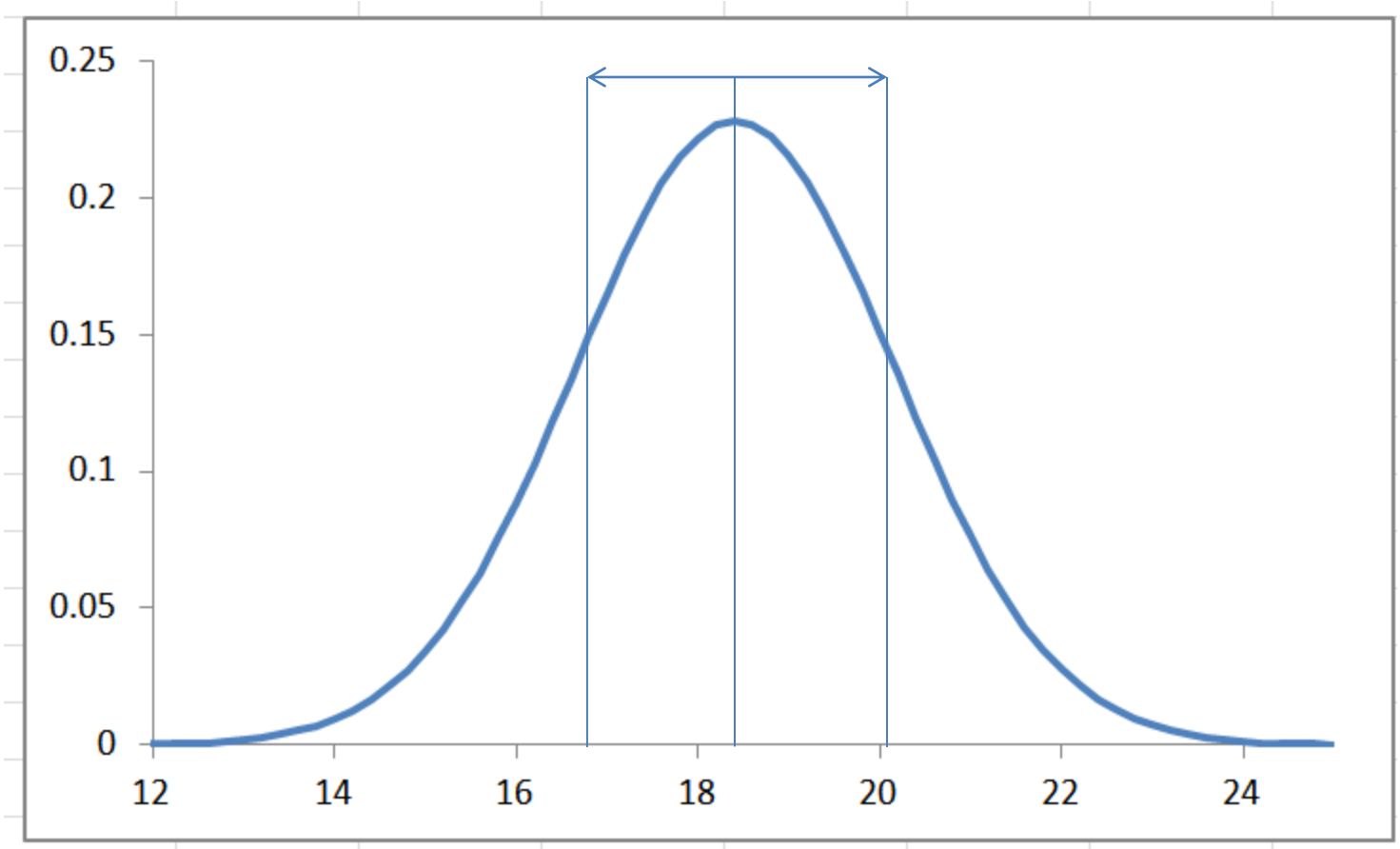
Acid-Soluble Iron in 160111

sdev: 18.41 ± 1.75

serr: 18.41 ± 0.21

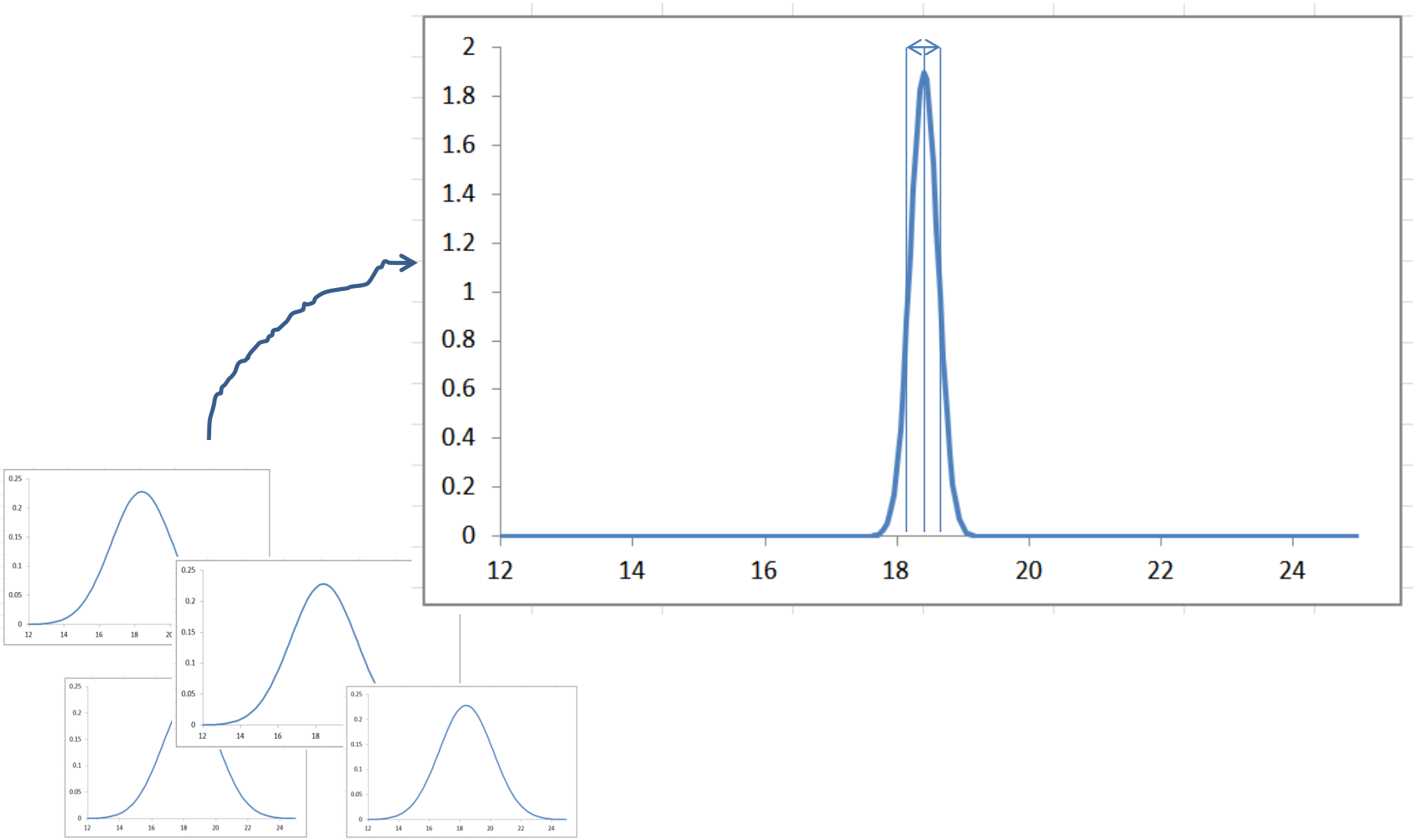
Standard Deviation

Dispersion of all results from 65 labs



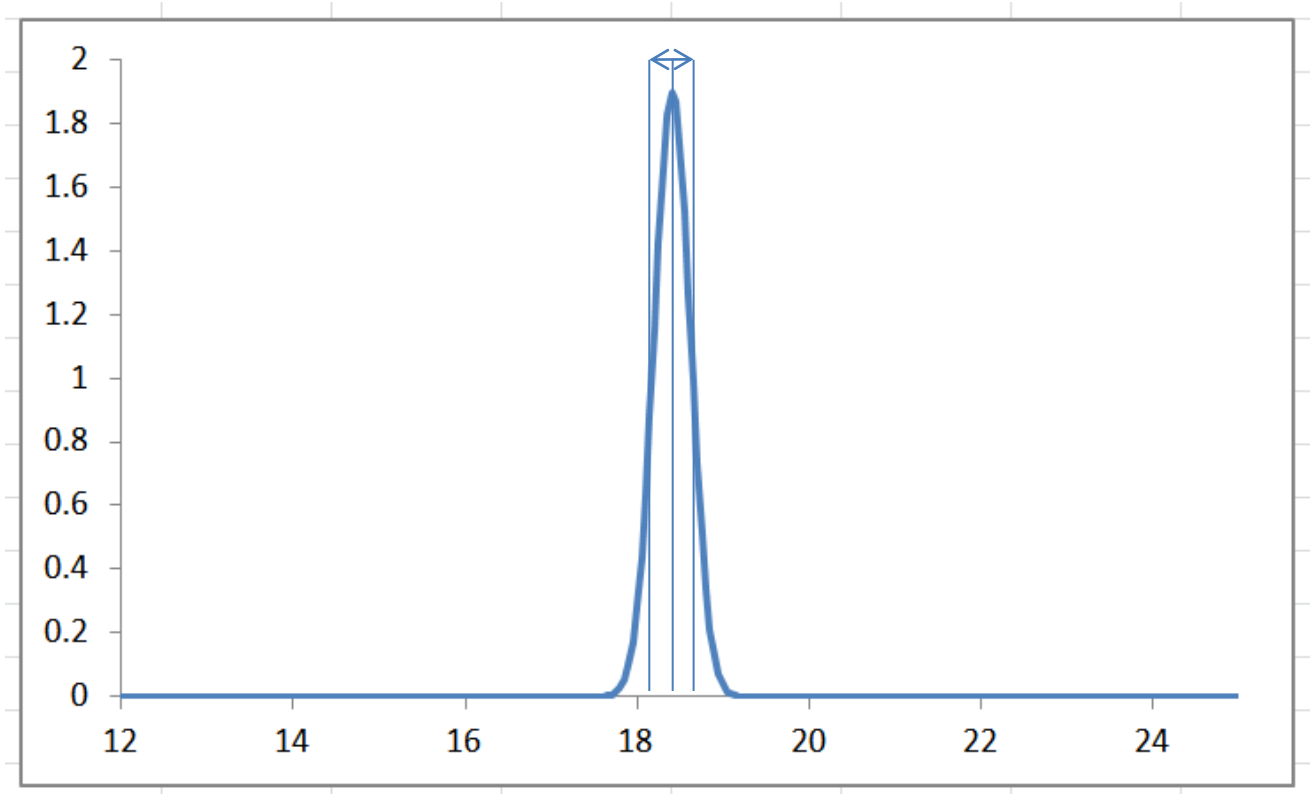
Standard Error

Dispersion of means from multiple sets of 65 labs



Standard Error

Provides estimate of the “true” mean



Standard Error

Provides estimate of the “true” mean

The higher the number of labs, the better the estimate.

Standard error = robust mean / $\sqrt{n}$