

Total Measurement Error

Laboratory Methods and Services

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Error in the Entire Measurement System

- Many data users want to know the total error in the results presented
- When error calculations are presented the data user thinks it refers to the total error in the result
- Does it?
- Does the decision maker need to know the error in the entire measurement system?

Errors in the Measurement System

- Analytical errors
 - weighting/dispensing errors
 - extraction errors
 - injection errors
 - instrument errors
 - matrix interferences (errors)
 - calibration errors
 - etc

How many systems/procedures are there to define, detect and control errors?

Errors in the Measurement System

- Laboratory sample processing errors
 - splitting
 - mass reduction
 - sieving
 - grinding
 - subsampling test portion or test aliquot
 - contamination
 - loss of volatiles and fines
 - etc

How many systems/procedures are there to define, detect and control errors?

Errors in the Measurement System

- Field sample collection errors
 - improper tools
 - not enough increments
 - not enough mass
 - incorrect selection of decision unit
 - Incorrect sample preservation
 - incorrect sample packaging and transportation
 - etc

How many systems/procedures are there to define, detect and control errors?

What Needs to be Done?

- Put systems/procedures in place to define, detect and control **all** errors?
- Will these procedures be identical to existing ones?
- Who is responsible for implementing these systems/procedures?
- **Who is responsible** to estimate the total error in the analytical result?

Who...

- Has the expertise to put systems in place to measure error?
- Has more “clout” than most other divisions?
- Has more at stake than most other divisions?
- At some level someone is responsible for the overall quality of the data

The laboratory?

How Does the Laboratory Handle Analytical Methods?

- Verify the science
- Validate the method
- Control chart
- Reference materials
- Check sample programs
- Accreditation and auditors
- and the list goes on

Applicable to field methods?

Laboratory Measurement Error

- Precision
 - replication
- Bias
 - analysis of known materials
 - alternate methods
 - spikes
- Gross
 - systems
 - procedures

Field Measurement Error

- **Precision**
 - replication (of sample collection process)
- **Bias** (cannot be effectively measured so must be controlled)
 - sampling bias
 - analyte bias
 - contamination of analyte
 - addition of analyte
- **Gross**

Lab vs Field QC

- More “relevant” in the field than in the lab
 - less controlled environment
 - larger potential source of error
- Can be harder to implement in the field
- More critical with new and emerging contaminants
- Must at least be considered in any sampling campaign

Quality Control

- **Necessary to determine**
 - if sampling is in control
 - what the magnitude of the error
- If it is important in the lab, it is even more important in the field
- What QC is currently performed in the field?

answer:

Lab vs Field Methods

- **Lab analytical methods**
 - certifying body
 - lots of research, performance criteria
 - quality control to demonstrate performance
- **Field sampling methods**
 - none of the above
 - selection of method more difficult and more a function of...?

Quality Control

- It involves effort in the field
- How often does it need to be done?
 - every time
 - certain percentage of the time (e.g., 10%)
 - enough to prove a method
 - critical samples
- A balance between risk you are willing to take and resources you are willing to spend
- Philosophically, how can you spend tremendous resources in the lab that produces only a small portion of the error and no resources in the field where the errors are large?

Summary

- We perform quality control in the laboratory because of the potential for error
- We perform quality control in the laboratory to measure error
- There is more potential error in the field than in the laboratory
- Therefore, we should be performing more quality control in the field than in the laboratory