Proficiency Testing of Fire Assay Laboratories— Proposed LBMA scheme

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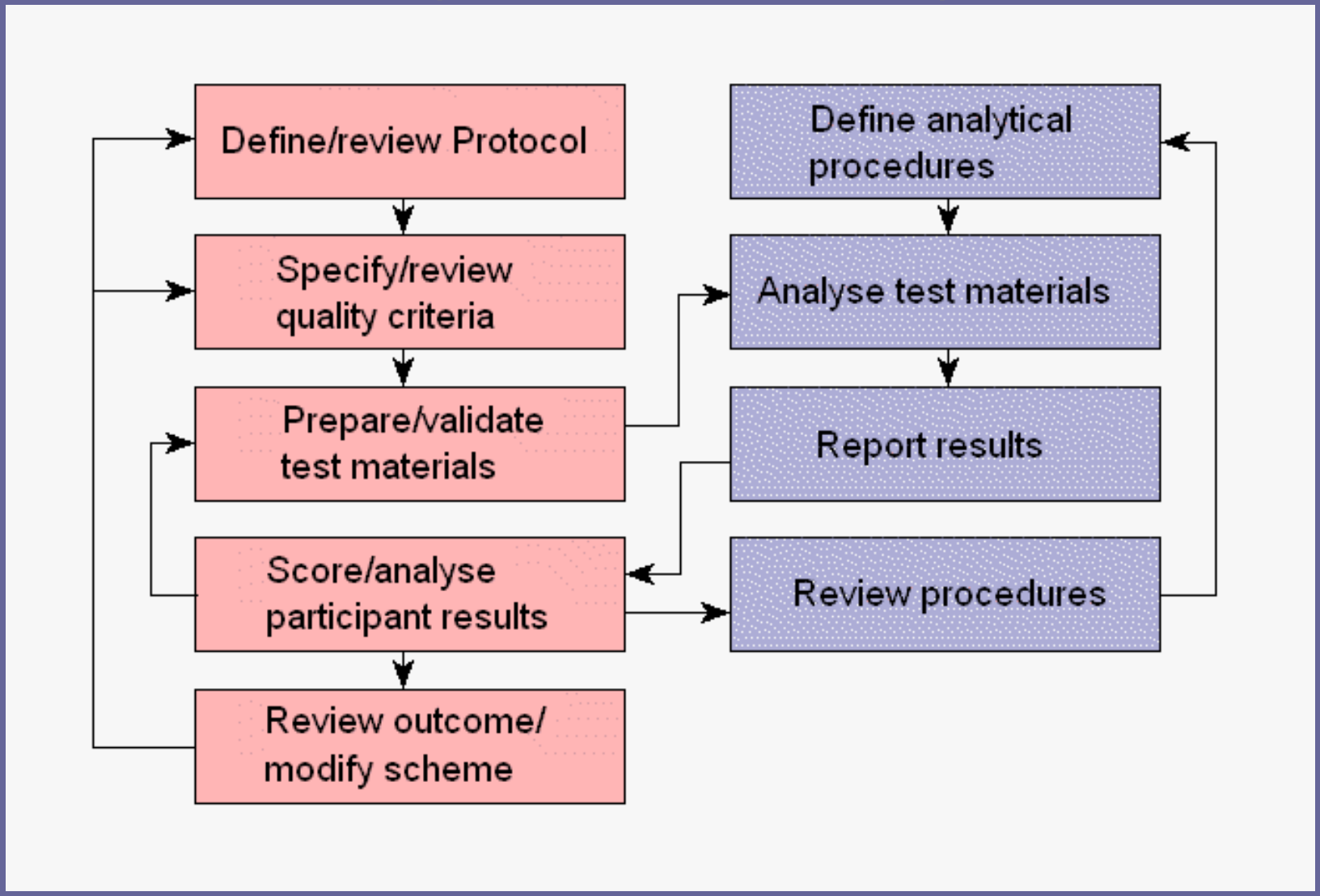
Aims of Proficiency Testing

- The provision of a regular, objective and independent assessment of the accuracy of an analytical laboratory's results.
- The promotion of improvements in the accuracy of routine analytical data.
- Primarily for the benefit of participants.
- But…a requirement for accreditation.

Proficiency testing in context

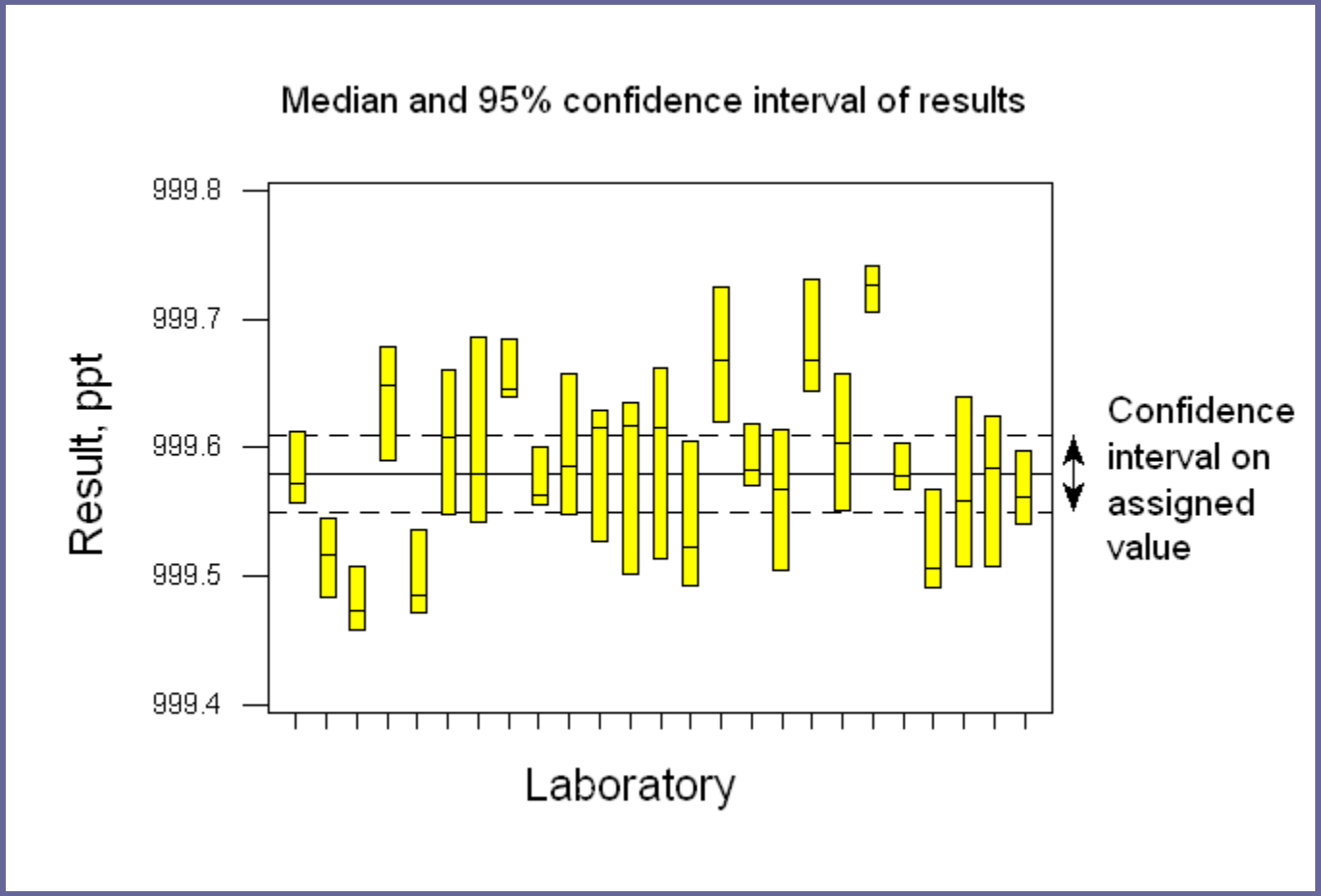
- To study the performance of routine methods.
- Conditions should be as realistic as possible.
- PT does not dispense with the need for internal quality control and other aspects of quality assurance.

Organisation of a proficiency testing scheme



A simple display (simulated results)

based on participant's individual mean and standard deviation



Precision and uncertainty

Repeatability (within-laboratory) standard deviation

is smaller than…

Reproducibility (between-laboratory) standard deviation

May be smaller than…

Standard uncertainty

Criteria for an ideal scoring method

- Easily understandable.
- Is transferable between different concentrations, analytes, matrices, and measurement principles.
- *Evaluates* the data in relation to its intended use, rather than merely describing it.

The ‘z-score’

$$z = \left(x - x_a\right) / \sigma_p$$

- x is the participant’s result
- x_a is the ‘assigned value’
- σ_p is the ‘standard deviation for proficiency’ (informally the ‘target value’)

Assigned value (and its uncertainty)

- Certified reference value.
- Result from a national reference laboratory.
- Formulation.
- Consensus of ‘expert laboratories’.
- Consensus of participants.

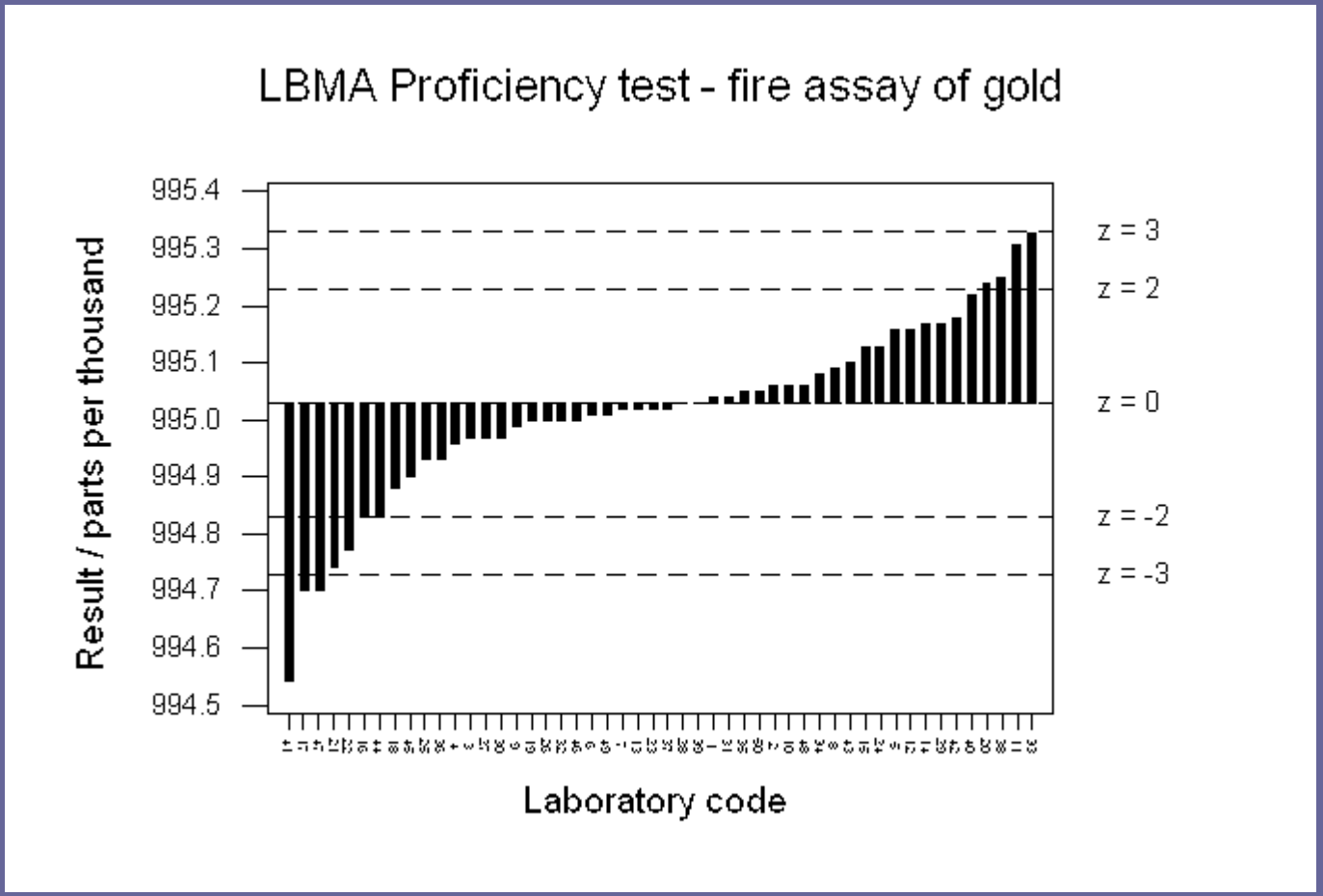
The target value σ_p

- Ideally should be an uncertainty that describes fitness for purpose.
- Usually the value is simply prescribed by the scheme provider to represent the general requirements for accuracy in the application.
- Experience and professional judgement are required.

In a (hypothetical) exactly-compliant laboratory…

- z-scores will tend to resemble a random sample from N(0, 1).
- About 95% of scores will be between ±2.
- Only about 0.3% of scores will be outside the limits ±3, which can be identified as action limits.
- Better performers will receive fewer of these extreme scores.

z-Scores—simulated round



Non-compliant laboratories—acting on unfavourable z-scores

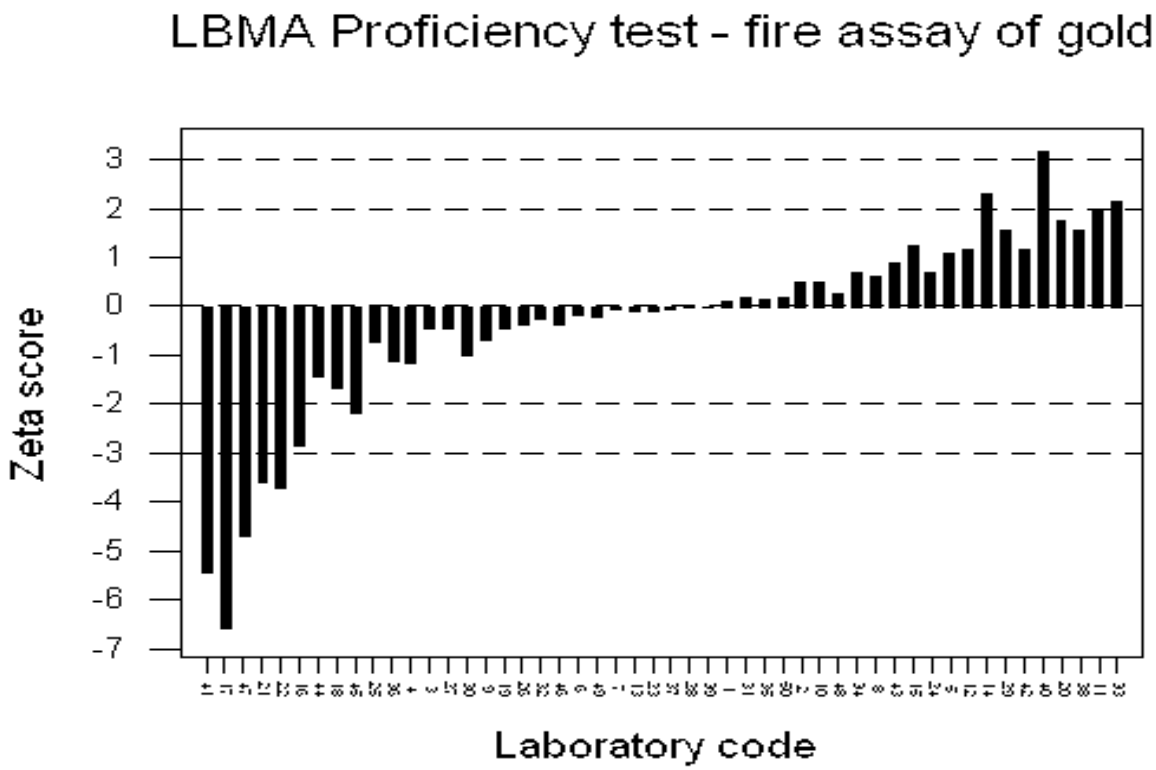
- A non-compliant laboratory would have an uncertainty greater than σ_p and/or a bias.
- It will receive a higher proportion of scores outside the range of ±3.
- A score of $z<-3$ or $z>3$ calls for investigation and remedial action.

The ‘zeta-score’

$$\zeta = \frac{x - x_a}{\sqrt{u_x^2 + u_a^2}}$$

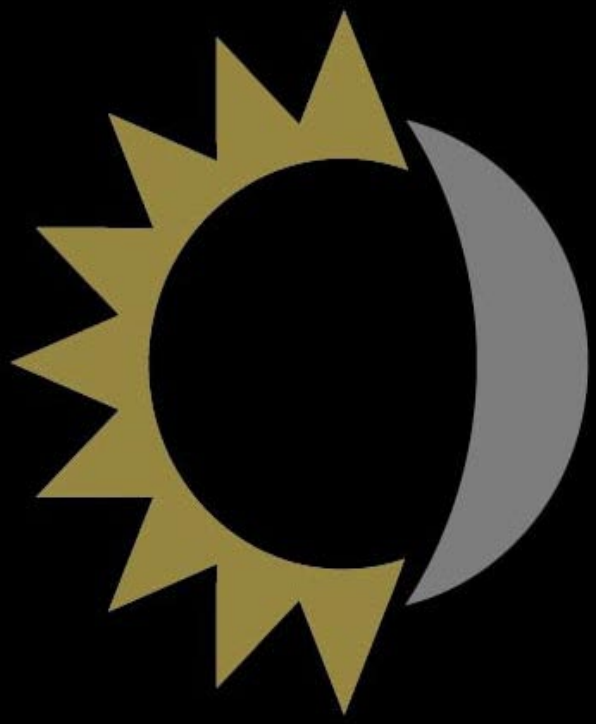
- x is the participant’s result.
- x_a is the ‘assigned value’.
- u_x is the estimated uncertainty of x.
- u_a is the estimated uncertainty of the assigned value (often negligible).

Zeta-scores—simulated round



Potential problems for proficiency tests in assaying

- Results skewed because of an adjacent natural limit (*i.e.*, 100%).
- Use among participants of discrepant analytical methods.



LBMA