Reasoning with Incomplete Measurements

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1 Question

An instrument reports a quantity y with a bounded error e, so that $y = x + e$ and $|e| \le 0.04$. A decision rule accepts the reading when $y \ge 1$. What can be concluded when the observed reading is 1.02?

2 A bound before a point estimate

The observation does not identify one exact value of x. It identifies an interval:

$$1.02 - 0.04 \le x \le 1.02 + 0.04, \qquad \text{so} \qquad 0.98 \le x \le 1.06.$$

The interval crosses the decision boundary at 1. A confident statement that the underlying quantity exceeds the threshold would therefore be too strong.

Claim 1 *The observation alone cannot justify a deterministic accept decision about x when the measurement error is bounded as above.*

Response. Report the reading as compatible with both sides of the threshold. If the decision is consequential, take another measurement or choose a policy that explicitly handles the uncertain interval. The important step is to carry the error bound into the conclusion rather than silently dropping it.

3 A reusable checklist

1. State the observed quantity and its units.
2. Write the measurement model before calculating.
3. Propagate the stated uncertainty to the decision boundary.
4. Distinguish what is identified from what remains possible.

4 Conclusion

Mathematical notes are most useful when each result is accompanied by the assumption that makes it valid. A short bound can be more informative than a precise-looking point estimate when the data do not support that precision.