

# Uncertainty, confidence intervals and significant figures

EE-209 Eléments de Statistiques pour les Data Sciences



## Margin of error and reporting numbers at an appropriate precision level

In statistical estimation the level of uncertainty  $u$  is determined rigorously by confidence intervals: for symmetric CIs,  $u$  is the *margin of error*.

If a CI is of the form  $[\hat{\theta} - u, \hat{\theta} + u]$  then it is usually considered that

- 1  $u$  should be reported with  $k = 1$  or  $2$  (or at most  $3$ ) significant digits<sup>1</sup>.
- 2 the precision of reported values for  $\hat{\theta}$ ,  $\hat{\theta} - u$  and  $\hat{\theta} + u$  should be the same as for  $u$ .
- 3 the rounding should be done “outwards”, i.e. down for  $\hat{\theta} - u$ , and up for  $\hat{\theta} + u$ .

For example, if  $\hat{\theta} = 1.069871$  and  $u = 0.002415$ , we can calculate  $\hat{\theta} - u = 1.067456$  and  $\hat{\theta} + u = 1.072286$ ; if we keep 2 significant digits, then we report

$$u = 0.0024, \quad \hat{\theta} = 1.0699 \quad \text{and} \quad [\hat{\theta} - u, \hat{\theta} + u] = [1.0674, 1.0723].$$

If the first significant digit in  $u$  is a 1, 2 or 3 we usually keep more significant digits than if it is a larger number, because the relative error produced by rounding is larger.

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<sup>1</sup>The **Guide to the Expression of Uncertainty in Measurement (GUM)** published by the Joint Committee for Guides in Metrology (JCGM) recommends to report uncertainty “to at most two significant digits” (7.2.6).